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Sand-Asphalt Pavements in North Carolina

Method developed by State Highway Department for paving roads through sparsely settled districts where fine sand is the only material locally available. Small portable type of mixer used. All sand used passes forty-mesh sieve.

Eastern North Carolina contains many miles of roads through a sparsely populated country where the soil consists entirely of fine sand, with no stone, gravel, concrete sand or topsoil within a radius of 150 miles; while, moreover, some of the roads that should be improved are 10 to 15 miles from the nearest railroad. Under these conditions engineers of the State Highway Commission endeavored to discover or develop some method of treatment that would give reasonably good roads under light traffic at small expense.

Massachusetts, Delaware and Florida have experimented with mixtures of local sand and asphalt, but rather smooth like beach sand. To ship in coarse sand to bring the material up to a sheet asphalt grade would have been prohibitively expensive. It was finally decided to use the fine sand, maintaining a uniform grading between the 40 and 200-meshes, and the results of this have been entirely satisfactory to date.

In describing this work in a paper before the American Roadbuilders Association, E. R. Olbrich, recently construction engineer of the North Carolina State Highway Commission, said: "The use of this fine sand without an admixture of coarse sand represents one of the most important developments in the sand asphalt pavement, and is a radical departure in sheet asphalt construction. It opens up a much wider field for the use of sand-asphalt pavement, in that it provides much greater areas in which the local sand may be used."

ROAD OVER FINE SANDY SOIL BEFORE TREATMENT.

North Carolina has developed a sand-asphalt type different from any used elsewhere and considers it entirely past the experimental stage. About 40 miles of this road were built last year by state forces and a considerable mileage is under construction this year, partly by contract and partly by state forces. The first pavement of this type has been down nearly two years and has proven very satisfactory.

Investigation of the sand through this section of the State showed that it was similar to that used for sheet asphalt except that practically all of it passed a 40-mesh sieve. It is practically pure silica, clean, hard and fairly angular, with a surface worn

In describing the work done last year, Mr. Olbrich states that the ideal setup for an asphalt plant for sand-asphalt pavements is one where the road parallels a railroad, and a borrow pit yielding the desired grade of sand is found along the road about midway of the project. Asphalt and filler can then be shipped in on the plant siding, while the sand is hauled directly from the pit to the dryer by slip teams. Some-

ROLLING BASE COURSE.

times, however, the only available sand pit was located some distance either from the railroad or from the highway.

The mixing operation is similar to that employed for sheet asphalt. A small portable type of mixer was used that turned out about 700 square yards of 3-inch base, or 1,400 square yards of 1½-inch surface, in a 10-hour day.

The pavement construction was started at the plant and proceeded away from the plant so that the hauling of the mix could be done over the finished pavement. It has been found economical to use light, pneumatic-tired, 1-ton trucks for this purpose.

The road was built 10 feet wide in some places and 16 feet in others, but the grade was built to a uniform width of 30 feet, including shoulders. It was found impracticable to roll sand fills and subgrade with a large tandem or steam roller, and a grooved or ring roller has been utilized to search out the soft places and give a uniformly solid subgrade.

The forms are solidly staked to line and grade and the fine grading of the subgrade is completed. The base course mixture is then delivered at the road at as low a temperature as is consistent with proper raking and spreading, as it is necessary to delay the rolling until the base course has cooled sufficiently to permit satisfactory rolling of the loose raked material on the sand subgrade. The base is rolled with an 8-ton tandem roller. Following this, the surface course is laid at a uniform high temperature of 300 to 350 degrees F., thus assuring a good bond between the base and surface courses. Templates are used in spreading both base and top courses and the finished surface is checked with a straight edge. The base course is laid with a compacted depth of 3 inches and the surface course with a compacted depth of 1½ inches. No filler is used in the base course mix.

A COMPLETED SAND-ASPHALT ROAD.

The cost of the first 10 miles of this material that was finished was $1.37 a square yard without the shoulder work; this figure including allowance for interest, depreciation and overhead. Of four jobs in operation at the beginning of the year the average cost had varied from $1.30 to $1.80 per square yard. The figures of a fortnightly cost summary for project No. 200-B in October of last year, given by Mr. Olbrich, show the costs in detail. The following were the average costs per square yard: Hauling sand to dryer, 7.8c; labor drawing sand, 2.7c; fuel oil for drying sand, 13.1c; labor mixing, .7c; asphalt, 30c; dust, 6.2c; fuel for boiler, 4c; plant repairs, including plant engineer, 3.2c; demurrage and rent of asphalt cars, 3.7c; other plant labor, 7.6c. This gives a total of plant operation of 81c per square yard. Hauling to road, including truck drivers' pay, gasoline and repairs, averaged 11c. The road operation, including labor and material for headers, labor for fine grading, laying, raking and rolling the hot mix, averaged 27c. Superintendence, depreciation on both plant and road equipment and interest averaged 9c. This gives a total average cost per square yard of $1.25. This fortnight's work included construction of 2,200 lineal feet of road, laying 4,889 square yards of base and 3,731 square yards of wearing surface in twelve days of actual work.

Highway Intersections

An idea in remedying traffic congestion at the intersections of highways has been proposed by G. N. Lamb, district engineer of the Illinois Division of Highways, which, while it could not readily be applied to city streets, would seem to be quite practicable for highways.

His idea is to widen the roadway for 500 feet back each way from the intersection sufficiently to accommodate twice as many lines of traffic as is carried by the highway; that is, where the pavement is 18 or 20 feet wide, designed for two lines of traffic, it would be made 36 to 40 feet wide, or wide enough for four lines of traffic, for 500 feet each way from the intersection, the width changing gradually through a further distance of about 200 feet. In addition to this, the radius of the intersection curves would be made over 50 feet long.

This would permit cars to range themselves in four lines while being held up in one direction and, when the signal was given for moving again, these four lines of cars would have 500 to 1,000 feet of travel in which to gradually line themselves out into two lines. Also, the right-hand lane on each branch of the intersection would be reserved for traffic which intends to turn into the intersecting street. Lines are painted on the surface of the pavement showing the demarcation between the four traffic lanes, each of which is made nine feet wide. Just back of where the pavement begins to widen would be a sign directing traffic intending to turn to take the right traffic lane.

Mr. Lamb says that this design permits fully 100 cars to come to rest within the widened area on each of the intersecting roads while traffic is passing over the other one.

Highway Suggestions by Colonel Greene

In a recent address, Colonel Frederick Stuart Greene, superintendent of the New York State Department of Public Works, expressed some opinions that he had formed concerning highway design, especially concerning curves and width.

Concerning curves, he stated that, in spite of any laws that could be passed, automobiles would continue to travel around curves at from 30 to 40 miles an hour and that, therefore, all curves should be banked to provide for a 35-mile rate. In addition, the road should be widened at curves. Where there is an alternative between a grade and a curve, he would much prefer the former. He would rather have a short 9% or even 10% grade than a curve, believing that it offers less obstruction to traffic and causes less accidents.

Concerning the width of road, he considered nothing more important, believing that any road which is important enough for the state to widen should be not less than 18 feet wide, and main travelled roads should certainly be not less than 24 and preferably 27 feet. Sixteen feet is the minimum for a two-way road, 18 feet is comfortable and 20 feet is a luxury except in the heavily traveled sections where a great many wide trucks are meeting every day, where even 20 feet is a necessity.

Connecticut Highway Transport Survey

Results from the most intensive and carefully planned census yet attempted, and analysis and conclusions by the Bureau of Public Roads.

A transport survey of Connecticut highways was conducted by the U. S. Bureau of Public Roads in cooperation with the Connecticut State Highway Commission, beginning on September 11, 1922, and terminating in September, 1923. This was the most intensive and carefully planned census of highway traffic which has ever been attempted in this country and was made with the conviction that the facts obtainable by such a survey formed a prerequisite to the solution of many of the problems of highway construction and maintenance as well as of transportation. In reporting upon this survey, the U. S. Bureau of Public Roads gives credit to C. J. Bennett, state highway commissioner of Connecticut during the greater part of this period, and to the personnel of the Connecticut Highway Commission for their cooperation.

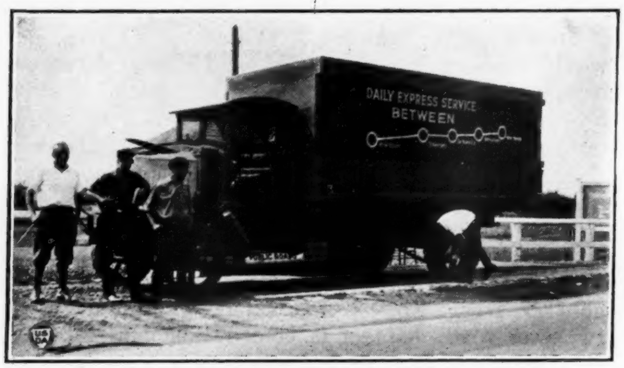
TRAFFIC ON BOSTON POST ROAD NEAR NEW HAVEN.
Illustrating the retardation of passenger vehicles by motor-truck traffic.

PURPOSE OF THE SURVEY

The primary purpose of this research was to assemble all the salient highway facts necessary to a critical analysis of highway transportation in Connecticut, where the transportation of both people and commodities is as highly developed at present as in any other section of the country.

The specific purposes which it was hoped to serve by the Connecticut survey were as follows:

1. To serve as an aid in allocating construction and maintenance funds according to the distribution of traffic over the highway system.
2. To predict future traffic.
3. To determine the daily and seasonable traffic density of



ALMOST TWO-THIRDS OF THE MOTOR-TRUCK MOVEMENT WAS REGULAR TRUCKING SERIVCE.

passenger cars and motor trucks on primary and secondary highways.

4. To determine the seasonal variations in the traffic movements of vehicles, commodities, net and gross loads for trucks of various capacities, commodity and capacity mileage.

5. To measure gross truck loads, net commodity loads, overloads above the capacity of the vehicles, overloads per inch of tire width on the pavement under load, and overloads per inch of tire width channel to channel.

6. To determine the average clearance width of trucks by capacities, and the relation of the width of truck body to truck overloading.

7. To determine the net tonnage movement of freight transported by regular and irregular trucking operators, the net tonnage of freight transported between cities, and the net freight tonnage of products of agriculture, products of animals, products of mines, products of forests, and manufactured products, transported between points of origin and destination.

8. To determine the average length of haul of motor-truck shipments by commodities, capacities, and production areas.

9. To determine the type of freight shipment by motor truck—whether a pick-up-and-delivery or terminal-to-terminal movement, and the packing and crating requirements for classes of commodities shipped. The results will indicate for the same commodities any difference in the packing and crating of freight for truck and rail shipment, and the prevailing type of shipment, pick-up-and-delivery or terminal-to-terminal.

10. To gather data concerning the relation of motor transport to other methods of transportation, particularly as to rates, commodity freight classification, schedules of population, delivery time between points, average commodity mileage, net tonnage, rates, and delivery time in the short, middle-distance, and long-haul zones.

11. To determine the average number of passengers and mileage per vehicle and the percentage of business and non-business movement of passenger cars.

12. To summarize the yearly passenger and commodity traffic over a state highway system, this summarization to serve as the basis for determining the service value of the state highway system for the transportation of passengers and freight.

FIELD FOR HIGHWAY TRANSPORTATION

During the past decade the growth of modern state highway systems has increased rapidly, stimulated by the realization of the economic and social values arising from the development of highway systems, by the increased economic utility of the motor vehicle, and the rapid yearly increase of motor vehicle ownership. Owing chiefly to the rapidity of this growth, there are very few authentic data from which to determine its economic value or sphere of operation as a correlated part of the transportation system of the country.

While some advocate increased development of inter-city transportation of freight on the highways, facts are not available for determining whether this new transportation factor should supplement or compete with the railroads. Particular attention is directed by the railroad officials to the fact that while railroad right-of-way and all the other property is taxed, a part of this revenue is used for constructing highways paralleling the railroads which are used by competing trucks who pay nothing for their right-of-way.

There is no question that problems of highway transportation and its relation to other forms of transportation cannot be answered satisfactorily by theorizing, or by individual judgments based on fragmentary evidence. Moreover, facts concerning highway transportation in one section of the country are not necessarily applicable to other sections; industrial, agricultural and other conditions all affecting the problem.

RESULTS AND CONCLUSIONS FROM THE SURVEY

Some of the general facts ascertained during the first three months of the survey were summarized in "PUBLIC WORKS" for June, 1923. Additional facts are given in considerable detail in an article by J. Gordon McKay, highway economist of the U. S. Bureau of Public Roads, in the March issue of "Public Roads," the official organ of the Bureau, and to this article and to the Bureau we are indebted for the following facts and for the accompanying photographs.

AN INTENSIVE WEIGHING STATION.
A 4-ton load of rabbit fur en route New York to Norwalk.

The recording of the field data was not so difficult as the statistical analysis of the information obtained. Empty-weight standards for all trucks have been evolved based upon actual empty weights for each make and capacity of truck with an allowance for body weight. These enable the determination of net tonnage of loaded vehicles.

In preparing for the census, commodity codes were developed, mileage charts between various origins and destinations in the area observed were computed in advance, and rules and regulations governing the recording of data and the coding of information were carefully prepared to insure the careful handling of the records. In planning the Connecticut survey, the U. S.

Bureau of Public Roads benefited by its experience in conducting the California highway transportation survey in 1920, the Tennessee survey of 1921-22, and the Connecticut survey of 1921.

The survey was made at eight intensive stations and fifty-six extensive stations, the information obtained at the former being: Density of traffic, motor truck makes, capacity, trips per week, trip time, origin, destination, mileage, commodity carried, type of shipment (whether pick-up-and-deliver or terminal-to-terminal), net and gross weights, state issuing license, packing and crating of commodities, tire data, regular and irregular motor truck operators.

At extensive traffic stations the data obtained for passenger vehicles were: Density, state issuing license, passengers per vehicle, business or non-business usage, origin, destination, and mileage. For motor trucks the passengers per vehicle and business or non-busines usage were omitted and for them were substituted data as to capacity, commodity, trips per week, and trip time.

Data recorded in the field were forwarded to Washington, coded and organized and punched on tabulating cards, thus permitting the use of mechanical sorting and tabulating machines. the records covered 40,613 motor trucks and 175,346 passenger cars during a period of three months in the year in question.

The figures as to density and distribution of vehicles show that the primary highway system in Connecticut carries the bulk of the highway traffic; that the greatest density of highway traffic is between the large centers of population, production and distribution; that motor-truck traffic forms a considerably larger proportion of the total traffic on the Boston Post Road from New Haven, Conn., to New York City, Hartford and Springfield, Mass., than on the less heavily travelled highways; and that at New Haven 15% of the total traffic is made up of motor trucks and 85% of passenger cars, while at Hartford only 10% is motor trucks. In addition, the reports indicate which are the major and minor highways and traffic routes, requiring the largest outlay for construction and maintenance; also those major routes which require constant supervision of construction, maintenance and policing to insure efficient service and safety.

SURVEYING TRUCK CARRYING 1½ TONS OF BANANAS.

SOME DETAILED CONCLUSIONS

Mr. McKay presents figures and diagrams giving conclusions on many minor points, the same occupying more than ten pages of the March issue of "Public Roads," to which those interested are referred. Some of the more interesting conclusions briefly stated are given below.

Winter traffic began decreasing in November, reaching a minimum in February, although, owing to the efficiency of the highway department in keeping the highways free of snow, motor-truck transportation did not fall below 40%, nor passenger-car traffic below 70% of that of October, when traffic was at a maximum. Part of the decrease was due not to winter road conditions, but to decrease in the perishable and seasonable commodities to be shipped during that season.

Considering the hourly variation, the first increase in volume begins at 4 A.M. and reaches a first traffic peak between 10 A.M. and noon and a second traffic peak between 2 and 4 P.M.; decreasing rapidly after 5 P.M. to 8 P.M., the movement between 8 P.M. and 4 A.M. being largely that of long-distance trucks. The percentage of overloads is considerably larger at night than during the day.

Analysis of loads shows that 29.6% of the trucks were loaded above their rated capacity. Records show the 2-ton and 5-ton trucks overloaded much more generally than those of greater and of less capacity.

The greater the capacity, the greater the average truck mileage. With the exception of the 5½-ton trucks, the average trip mileage of all capacities is less than 70 miles. The average mileage of pneumatic tired trucks exceeds that of the solid tires except for the 1½-ton truck and smaller. Of the 5 to 7½-ton trucks, those with pneumatic tires averaged 107.8 miles while those with solid tires averaged 61.4 miles. On the other hand, the average net load per vehicle was greater on the solid tires than on the pneumatics, this being due to the tendency to use pneumatic tired trucks for rapid delivery over long distances, transporting commodities of relatively high value and low weight.

On a ton-mile basis, trucks from outside the state use the Connecticut highway system more per vehicle than do Connecticut trucks. However, 89% of the motor trucks were Connecticut trucks, and they transported 86.5% of the total net tonnage.

A study of the return loads, which determine whether motor truck transportation is done at a profit or at a loss, showed that two-thirds of all motor trucks were loaded and one-third empty, the percentage of empty vehicles being largest in the one- to nine-mile trip limit; while in the longer hauls, from 10 miles to 70 miles and over, the percentage of loaded vehicles is a little over 70, or a trifle more than the average.

It was found that 62.3% of the truck movement was regular trucking service making from one to six or more trips per week.

In studying the volume of truck movement, it was found that 32.6% of the net tonnage was transported 30 miles or more and was, therefore, partially competitive with the railroads. A considerable part of this, however, was due to lack of efficient rail service between the points and the fact that certain types of commodities, such as household goods, wholesale groceries, etc., are especially adapted to truck shipment.

It was found that 81.5% of the commodities transported over Connecticut highways originated in the state of Connecticut, while only 18.5% originated in other states. On the whole, the majority of the service rendered by the Connecticut highway system is for Connecticut producers and consumers.

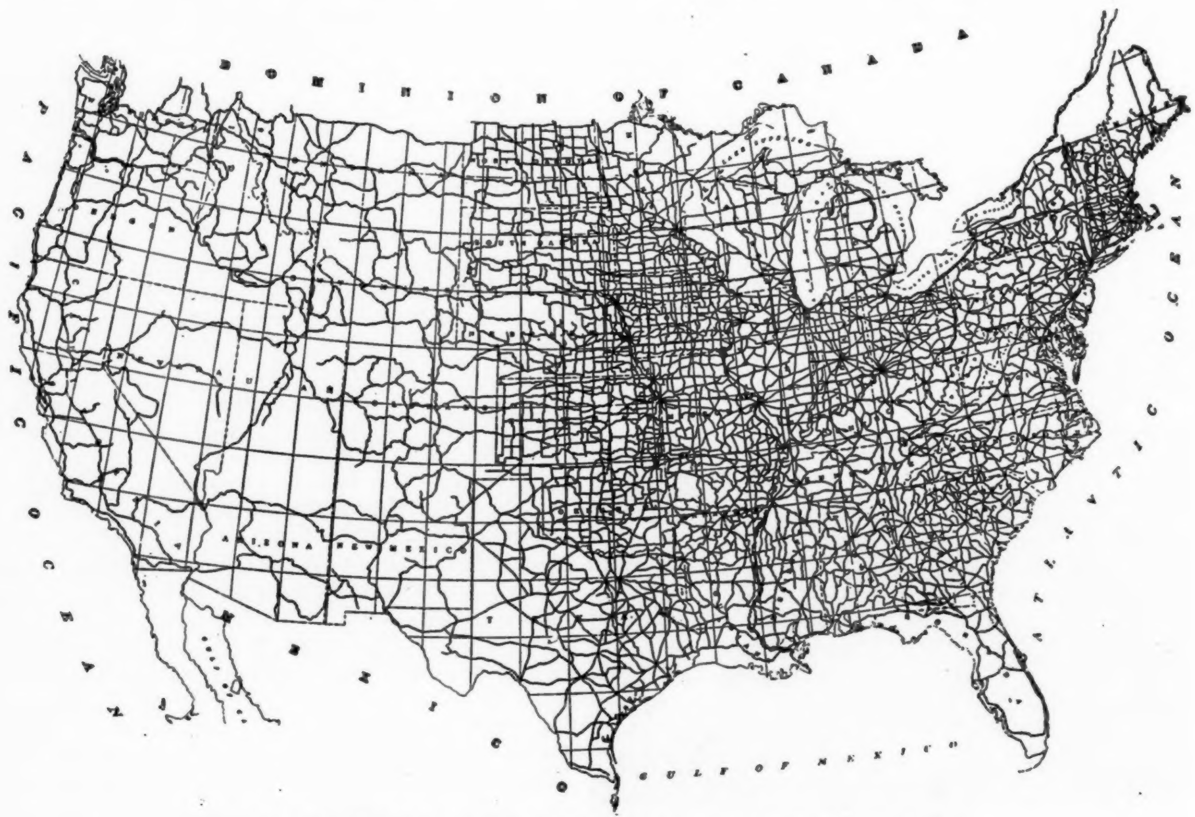
LEGITIMATE FIELD FOR TRUCK TRANSPORTATION

Based on this survey, the four main fields of operation for motor trucks in the transportation of freight are indicated as follows, in the order of their importance:

1. Organized urban motor truck transportation in congested rail and steamship terminal areas, consisting of motor truck terminal-to-terminal freight transfers as well as pick-up-and-deliver service.
2. The organization of motor truck freight service supplementing existing rail and water transportation systems, and operating in areas inadequately served with such transportation.
3. Short-haul transportation of freight in the New England area, approximately up to 30 miles or less.
4. Truck transportation of special commodities in the long-haul zone in which delivery, character of the goods transported, or demands of the industry or trade, indicate the desirability of motor truck transportation.

Competition with the railroads in more than 30-mile hauls has resulted in an improvement of the rail service in New England, following which the use of motor truck transportation in such competitive service has decreased.

Correlation of motor truck and rail service is developing. One trucking company assembles freight in the eastern New England territory tributary to the principal cities, carrying it to selected rail shipping points where it is taken by the New York, New Haven & Hartford Railroad. This trucking company ships an average of ten carloads a day from this territory, which freight goes to Philadelphia, Baltimore, Washington and other terminals on the Pennsylvania Railroad. Another trucking company cooperates with the Boston & Albany Railroad, and still a third acts similarly in cooperation with the New York Central. This trucking service is not competitive, provides a pick-up-and-deliver service, allocates the short haul to motor transportation and the long haul to rail or water, and provides rapid transportation for L. C. L. freight from consignor to consignee.



MAP OF HIGHWAYS WHICH FEDERAL AID WILL HELP TO BUILD.

This map shows the highways throughout the United States accepted by the Bureau of Public Roads for Federal Aid. While the small scale does not permit identifying individual roads in many cases, it indicates the relative lengths of Federal Aid roads per unit area in the different states and sections.

Paving Brick Varieties Reduced

Action of Permanent Committee last month further reduces number of varieties to five regular and one special.

Mention has been made several times in "PUBLIC WORKS" of the efforts being made by a permanent committee of the Department of Commerce to greatly reduce the number of varieties of vitrified paving brick manufactured in the United States. At the first conference in November, 1921, there were found to be about sixty-six different types and sizes being made. These had been reduced by successive eliminations to six, and it is very encouraging to note that at the regular annual meeting on March 28 of this Permanent Committee on Simplification of Varieties and Standards of Vitrified Paving Brick, the number of varieties was further reduced to five.

The five types now determined upon by the committee are as follows:

Plain Wire Cut Brick (vertical fibre): 3x4x8½ and 3½x4x8½.

(In each case the first figure is the depth, the second the width, and the third the length.)

Repressed Lug Brick: 4x3½x8½.

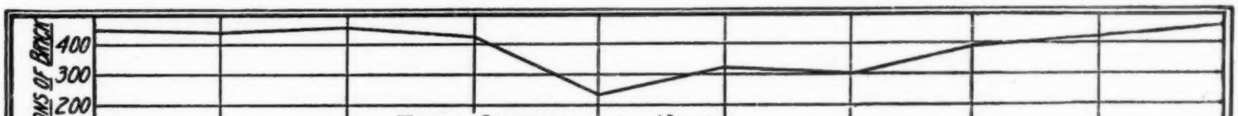
Wire Cut Lug Brick (Dunn): 3x3½x8½ and 4x3½x8½.

The one eliminated last month was the 3½x 3½x8½ wire cut lug. This elimination, like the others, was determined upon only after a survey of the industry's shipments had revealed that this size had steadily decreased in favor among the engineers of the country to a point where it constituted an exceedingly small percentage of the total shipments of the industry.

At this meeting the Committee established a standard for elimination, as a guide for future actions of the Committee, to the effect that "any variety of brick which shows less than 2½ per cent of total shipments for three consecutive years be eliminated and that any variety of brick which shows 5 or more per cent of the shipments for three successive years be reinstated in the list of recognized types and sizes unless special technical or other reasons show that such action is undesirable; provided, further, that the recognized types and sizes shall represent not less than 75 per cent of production." The size eliminated this year had constituted only 0.9 per cent of the shipments for 1923.

In addition to these recognized types and sizes, there is another type of brick not in the list although manufactured generally, namely, the "Hillside" variety. This is used very largely in hilly sections of the country, representing, however, only 4.1 per cent of the total production, and was put into the "special" class at this year's meeting and will in future be recognized, manufactured and sold as a special in the size 4x3½x8½.

At this meeting the Committee considered a survey of the vitrified paving brick industry for 1923 which had been made by the National Pav-



FLUCTUATIONS OF TOTAL SHIPMENTS OF PAVING BRICK AND TREND OF TYPES SINCE 1914.

ing Brick Manufacturers Association at the request of the Department of Commerce. This survey showed that the industry has experienced a steady growth since the year of minimum production—1918. Due to the effect of the War, shipments that year dropped to about 236 million. By 1921 shipments had increased to more than 392 million and in 1923 reached nearly 454 million. The fluctuations of total shipments and also the trend of certain types are shown by the accompanying diagram.

Some Notes on Contractors Plant

Comparison of light and heavy trucks and industrial railroads for handling materials on the job. Small contracts vs. large ones.

In a paper before the conference on highway engineering at the University of Michigan, E. G. Willemin, district engineer of the Michigan State Highway Department, gave a practical talk on "Contractors' Plant and Other Modern Developments Used In Constructing Concrete Pavements." The following are among some of the points brought out by him:

In the matter of transportation, one builder's experience leads him to favor the light truck, another a heavy truck, and still another the industrial railroad, and all have been used successfully. Mr. Willemin believed that the temperament of the contractor and his organization has something to do with the selection, but that there are certain economical principles involved also. "A piece of equipment is not justified in a well-balanced plant unless it coordinates closely in output with other units of the plant in giving continuous production."

A contractor must generally consider next season's work as well as this in buying his plant, for he has no assurance that a plant suitable for this season's work will also meet the requirements of next season's. "There is an opportunity at times for the state and counties to adapt projects to plants. It has not always been possible to do this, however, because of considerations such as taking care of traffic during construction."

"A small job with a small organization and small overhead can compete favorably in unit price with a large job with large organization and high overhead. The risk of delay is more costly in a large plant layout. The small plant layout has proven adaptable to a larger variety of jobs. . . . . To date it is my opinion that the average net return on the money invested for the large plant has been lower for a season's run than for the small plant."

"With light truck haul (a light truck being considered one of 2-tons' capacity or less) the truck makes up in speed what it lacks in capacity. Its use is favorable with comparatively short hauls; it is easier on the subgrade; parts are more readily replaced in case of breakdown; the time lapse is shorter after a rain for trucks to start running upon the roads; the interest charged on the capital invested is less. The investment of the owner in spare parts is appreciably cut. With heavy trucks, on the other hand, a long haul is advantageous. Due to the fact that for a given volume of haul, a less number of heavy trucks are needed, they require less field supervision, there are fewer units on the road to pass each other, less time to load than in four or more light trucks, they are on the subgrade a shorter time in unloading the same volume, thus disturbing subgrader work less. The drivers take more personal pride in the performance of their heavy truck. In fixed charges, the storage charge for a heavy truck is less than for its capacity equivalent in light trucks; license fees are accordingly reduced, while risks on insurance, liability, fire and theft are less. The charge-off for the life of heavy trucks can be taken as twice that of light trucks. Again, in sub-letting truck hauls it usually proves more satisfactory to sublet to heavy truck haulage concerns, as they are more substantial and trustworthy."

"The heavy investment necessary for industrial railway equipment is warranted only on longer projects. Their layout and operation require close study in regard to soil conditions, weight of track, grades, booster engines, temporary and permanent passing switches, loading facilities and tracks using gravity wherever possible in favor of the load. . . . . The industrial haul is more reliable in general as a transportation unit than the truck method. The reliability of the industrial haul should lead to continuity of production. Against this advantage we must add interest and depreciation of plant investment."

Concerning the finishing machine, Mr. Willemin said: "It is a labor-saving device, and I might say a life-saving device to humanely express its improvement over hand-finishing. By the use of such a machine, a drier and consequently a stronger concrete can be properly laid. The tamping action is particularly effective, tending to make a denser concrete and to flush grout to the surface for a smooth finish."

Educating Highway Contractors

The Pennsylvania State Highway Department is endeavoring to help contractors who bid on its work, as well as to secure better work because of the information thus given them, by means of object lessons; taking advantage of the presence of contractors at lettings to give them the information. Arrangements were made so that those visiting Harrisburg, April 7th and 8th in connection with a letting for highway work on those dates would be given an opportunity to visit a concrete roadway under construction near Duncannon. Here they were shown the method of building into the road the white

cement traffic dividing line recently approved by the Department, different methods being tried out. There was also arranged a demonstration in connection with placing the new reinforcing bars to be used this year instead of wire mesh formerly employed; this reinforcement consisting of six longitudinal bars instead of the galvanized mesh, thus securing more steel to the square yard at less cost per mile.

That the contractors need information concerning the placing of the white cement line in the road is evident from the fact that they have been bidding anywhere from 6 cents to $1.30 a foot for such line.

Highway Lighting

By W. S. Herrmann*

Advantages of lighting the more important thoroughfares and requirements of lighting units used. Incidental benefit to farmers.

The enormous increase in the use of highways for long-distance traveling by trucks and automobiles, and the ever increasing number of accidents at night, bring out the importance of the proper lighting of the more important thoroughfares by some other means than the headlights of the vehicles themselves.

A well illuminated road will relieve congestion of traffic on the highway during the day because heavy truck traffic may move safely at night, thereby preventing many accidents.

The danger of attack by highwaymen is also eliminated by highway lighting, as the light attracts desirable traffic and conversely repels the highway robber, who prefers the poorly lighted districts. Highway lighting makes driving at night as safe as by day.

The proper lighting of highways must be of such character as to enable the driver to see for a considerable distance in order to slow down or stop for pedestrians or vehicles. Curves and ditches as well as railroads and highway crossings must be clearly visible. All this has been accomplished by powerful headlights on cars, but on account of the dangerous glare to the approaching vehicle and also due to the insufficient illumination as a result of dimming, this method will have to be discontinued in favor of highway lighting.

Usually a power line will be found running along the main travelled highways. These same poles may be used to carry the wires of a series circuit for lighting the highway units, which are mounted by means of short brackets directly to these same wooden poles. By such a system, uniform illumination without glare at a minimum cost will be assured, provided the proper type of highway unit is used. Naturally the most important factor in the system is the lighting unit, which must be especially designed for the purpose.

Highway lighting units must be designed to cover the following points:

1. To uniformly illuminate the highway on spacings of from 300 to 400 feet and mounting heights of from 25 to 30 ft.
2. To be without dangerous glare.
3. To be easily adjusted so as to diffuse the light to the road surface.
4. To be bug and dust proof, as well as moisture proof.
5. Easily replaced and accessible to the maintenance man.
6. To present a minimum useful (or reflecting and refracting) surface to dust and dirt depreciation.
7. To be so designed that the action of the wind will not whip the unit out of alignment.

*Of Westinghouse Electric & Manufacturing Company.

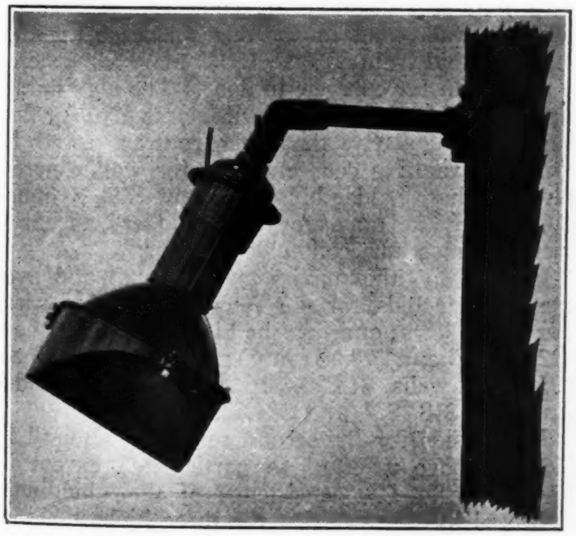


FIG. 1—LIGHTING UNIT DESIGNED ESPECIALLY FOR HIGHWAYS.

FIG. 2—LIGHTING A HIGHWAY, USING THE TYPE OF UNIT SHOWN AT THE LEFT.

A unit designed to meet these requirements is illustrated by Figure 1.

The excellent results obtained by the use of such units equipped with 250 candle-power lamps spaced 300 ft. and mounted 30 ft. above the road surface are shown by Figure 2.

The most recent installation of highway units in Wayne County, Michigan, is located on Grand River road, or M-16, which runs from Detroit to Grand Rapids through Lansing, the State Capital. These units are installed on a stretch of a little over three miles between Redford and the Baseline road. Fifty-nine Westinghouse Highway units, equipped with 250 candle-power series lamps are mounted 30 ft. above the road surface and spaced about 250 ft. apart. The system is constant current series, using pole-type regulators and controlled by a time switch. The road is concrete and 20 ft. wide.

The system is owned, operated and maintained by the Detroit Edison Company, which charges Redford Township $3.00 per unit per month on an eight-year contract. The poles upon which the highway units are mounted are also used for transmission, distribution, Detroit United Railway feeders, or trolley extension arms.

In this connection it is well to consider rural lines. Highway lighting is one of the most beneficial ways of helping the farmer get electricity to the farm. The average number of prospective farm customers per mile is three. In the cities it may be two hundred or more. Therefore, the rural customer cannot expect to get service for the same rate as the city customer. However, if the counties could spend road money for lighting the main travelled highways, the central station would receive the equivalent of 17 additional customers per mile and then be in a better position to bring electricity to the farm and maintain the lines and receive a fair and just return on their investment.

Highway Lighting

IN CUYAHOGA COUNTY

Owasco Street, Auburn, N. Y., extends as a county highway to a resort on Owasco Lake, passing the Country Club, a distance of slightly over two miles. The travel to the lake over this road, which is also a part of the main highway to Moravia and the south, is very heavy, and by vote of the residents a lighting district was created several years ago embracing this two miles of road. Power was secured from the Empire Gas & Electric Company of Auburn, and lights were placed over the center of the highway at intervals of 800 to 1,000 feet.

This might not have been practicable had it not been that power generated by the Niagara, Lockport & Ontario Power Company was so convenient and cheap.

Another lighting district was created two years ago in the extreme north end of Cuyahoga County, power for this being secured from the Salmon River project, and in this way the main road through Fairhaven in the town of Sterling was lighted. In both cases the lighting of the roads was made practicable by the fact that many of the residences, farms, etc., along the road, used considerable current for power as well as for lighting.

We are indebted for the above information to J. Charles Dayton, superintendent of highways of Cuyahoga County.

MILWAUKEE COUNTY

Eight miles of highways in Milwaukee County, Wisconsin, are lighted, using about the same system as is employed in the city of Milwaukee —ornamental concrete poles with connecting cables placed underground. These eight miles, says W. F. Cavanaugh, county highway commissioner and planning engineer, are in scattered sections starting at the Milwaukee city limits and extending outwards for short distances. Along these highways conditions approach average city conditions.

Some Remarkable Bids

A few weeks ago the Board of Public Works of Seattle, Washington, received eleven bids for paving a certain street. The lowest of these was $30,877 and the highest was $33,092. We believe it is unusual in paving, or almost any other work, to find the highest and lowest of eleven bids differing by less than seven per cent.

At about the same time sixteen bids were received for two reservoirs for increasing the water supply of the District of Columbia. The largest items in this work were those of excavation and concrete. For the first reservoir, the estimate included 75,000 cubic yards of the former and 13,310 cubic yards of concrete. The total bids for this reservoir varied from a minimum of $268,490 to a maximum of $441,195, or more than 60%.

Perhaps the most peculiar feature of these bids, however, is found in the bids for concrete put in by the highest bidder for the first reservoir. There were four classifications of concrete—in floor, in piers, in walls, and in vaulting. Except the high bidder, all bid from 30% to 150% more for concrete in piers than for concrete in floor. The high bidder, however, bid 50% *less* for pier concrete than for floor concrete. Similarly, the other contractors all bid more for vaulting concrete than for wall concrete, while the high bidder bid only about 55% as much.

Certainly the minds of some bidders appear to operate in most unaccountable fashions.

Incidentally, the maximum, minimum and average concrete bids for the four classes of concrete were as follows; omitting the high bidder: In floor, $12, $17.45 and $14.18; in piers, $16.35, $36.63 and $25.06; in walls, $13.20, $16.90 and $14.93; and in vaulting, $18, $31 and $24.52.

In the bids for the second reservoir, also, all the bidders above referred to participated except the high bidder. The consistency of their bidding is indicated by the fact that the three highest bidders and the three lowest were the same on both jobs; also the second highest group of three.

Comparative Study of Imhoff Tanks*

Preliminary treatment and character of sewage at each of the four plants studied. Importance of temperature in sludge digestion.

Mr. Eddy has calculated also the per capita volume of scum compartments with the results shown in the table.

CHARACTER OF SEWAGE

The results obtained will naturally be affected more or less by the character and composition of the sewage. The sewage at Schenectady and at Plainfield is from separate systems, while the other cities are on the combined system. It is suggested that the mineral matter in the combined sewage may tend to weight down the organic matters and thus limit scum formation. Also, since these inert matters give off no gas, the volume of gas produced per pound of solids in the tank would be less. Mr. Downes suggests that sand mixed with the solids may render them more penetrable to the attacking organisms; and that the movement of the mineral solids, as

Plant	Scum Compartment: Volume—Cu. ft. per capita	Scum Compartment: Loading—lbs. per year per cu. ft.	Gas Vent Area: Per cent. of total tank area	Gas Vent Area: Sq. ft. per cu. ft. of sludge space	Gas Vent Area: Loading—lbs. per year per sq. ft. gas vent area
Schenectady	0.76	40.4	14.8	0.034	644
Plainfield	0.72	32.1	14.3	0.023	674
Fitchburg	1.59	28.5	15.0	0.031	777*
Rochester	0.55	49.7	26.8	0.013	849

*Side vents, 385; central vents, 2040.

The loading is based on the entire weight of solids deposited in the tanks, without attempting to subdivide them into those which may constitute sludge and scum, respectively. This shows the least volume and the greatest load at Rochester, where there is no accumulation of scum. The volumes of the scum compartments may not have the same ratio as the areas of the gas vents. The table shows the area of the vents of the four plants. Rochester is seen to have the largest ratio as compared to total tank area, but the smallest area as compared to sludge space. Mr. Eddy believes the latter is the more important relation and that, therefore, the comparison tends to support the claim of those who believe that small gas vents are preferable to large ones.

PRELIMINARY TREATMENT

For preliminary treatment, fine screens have been installed at Rochester and at Plainfield, while at the other two plants the sewage is passed through coarse racks, and at Fitchburg through grit chambers also. Fine screening may aid in preventing foaming and scum at Rochester and has certainly had this effect at Plainfield. Fine screening not only reduces the amount of organic matter to be digested, but gas is more easily liberated from gas-lifted masses of finely divided solids than from masses of coarse solids which tend to interweave and hold together. Mr. Lewis believes that it is just as economical, if not more so, to remove the floating solids and inert materials in the sewage before they reach the tanks as to provide additional space for them in the tanks. Mr. Skinner states that the fine screens at Rochester remove mainly garbage and other relatively non-putrescible material (the sewage being quite old); which screenings, if not removed, would add 4 to 6 cubic feet per million gallons of relatively inert matter.

*Continued from page 79.

gas passes up through the sludge, may even produce an attrition effect.

As to freshness, the Schenectady and Plainfield plants receive fresh and stale sewage, respectively, as do the Fitchburg and Rochester plants, yet the two former have proved troublesome and the two latter have not. Industrial wastes do not appear to have been present in any of the sewages in sufficient quantity to materially affect their composition. The water supplies at Schenectady and Plainfield are comparatively hard; that at Fitchburg is distinctly soft, and that at Rochester is between the two. (Mr. Skinner states that one of the water supplies of Rochester has a hardness of 122 parts per million, and that this has the effect of causing grease balls in the scum.)

It appears that neither freshness nor hardness produced any observable effect upon the satisfactory operation of these plants.

The strengths of the sewages in parts per million of suspended solids are remarkably similar at all of the plants except Fitchburg, which is considerably stronger than the others. The suspended solids average 55 grams per capita in the seperate sewages and 75 in the combined sewages, and the author assumes that the difference, or 20 grams, is accounted for by detritus washed in from the streets. The proportion of suspended solids removed varied from 44 per cent. at Rochester to 76 per cent. at Fitchburg, the latter including sewage pumped back into the Imhoff tank from the secondary tanks. However, 71 per cent. was removed directly at Schenectady. If the volumes of sewage and tributary populations be taken into account, it is found that Fitchburg's contribution is 56 grams per capita per day deposited, or 93 per cent. greater than that at Plainfield. The great difference in amount of suspended solids per capita collecting in the tanks forcibly illustrates the

objection to designing sludge compartments upon the basis of a uniform volume per capita taken as a general standard.

Temperature—As already stated, temperature is believed to have an important effect on sludge digestion. However, scarcely any temperature determinations have been made. The author gives temperatures taken at Schenectady showing a maximum of 66 on September 6, 1923, and a minimum of 55 on November 9; while one reading at Plainfield in September gave a temperature of 60 to 61 and one in Fitchburg on November 8 a temperature of 57. Since the data were collected, readings were taken in the Schenectady tank, Mr. Lewis stating in his discussion that "a fully compensated recording thermometer has been used for about two years to record the temperature of the air. Recently, another fully compensated thermometer has been installed in the Imhoff tanks, the bulb being immersed in the liquid contents of one sludge compartment about 3½ feet from the bottom. Unfortunately, funds were not available to purchase an instrument equipped with two bulbs and recording movements which would furnish a continuous record of the temperature of the sewage in the settling chamber at the same time." The temperatures of the sewage and effluent are read once daily with a coal oil thermometer. The sewage temperatures showed a variation from 54 on Dec. 31st to a minimum of 50 on Jan. 1st, 2nd and 4th. The temperature figures which Mr. Lewis submitted "show that there is a marked hourly variation in the temperature of the contents of sludge digestion compartments, dependent on atmospheric and other conditions, and that a record of the variation between the temperature of the air, sewage, and contents of the digestion compartment can be obtained by the use of suitable graphic thermometers." During the height of the warm weather the maximum temperature obtained in the digestion compartments was 67 degrees, and during the cold weather of January the temperature varied from 47 to 52. Mr. Lewis suggests that the use of considerable quantities of city water, with temperatures varying from 41 to 58 degrees, for mechanically agitating the scum may have an important effect in lowering the temperature of the sewage and retarding digestion.

The subject of temperature was also discussed at some length by Mr. Hartwell, who suggested that in a shallow tank the temperature might be affected more appreciably by changes in air temperature than would be the case with a deep tank, analogous to water in deep and shallow wells, and consequently would be colder during the winter months. "Recent tests at Fitchburg indicate a temperature between 44 and 45 degrees in the digestion compartments of all the Imhoff tanks at a pont about 4 feet below the slots. These tests were made after a period of zero or near zero weather for several days and probably indicate a minimum temperature under normal winter conditions."

Mr. Eddy introduced the result of a test of a septic tank made at Worcester, in which the gallons of gas evolved per hundred gallons of sewage varied from 1.17 in January with an average temperature of 48.2 to a maximum of 6.69 in September when the sewage temperature was 66.6, the amount of gas increasing with the temperature of the sewage but being over three times as great between 65 and 70 degrees as it was below 55 degrees. On the basis of this relation between temperature and digestion, Mr. Eddy made a calculation of theoretical sludge accumulation in an Imhoff tank designed to receive from combined sewage 100 pounds of deposited solids per month, average temperature for each of the months being assumed, varying between 47½ for February and March to a maximum of 70 in August. Beginning with no sludge in the tank in October, he estimates 70 pounds in November, 145 in December, 225 in January, 310 in February, 395 in March and 475 in April; following which withdrawal of sludge began and the quantity rapidly fell to 405 in May, 325 in June, 235 in July, 140 in August, 70 in September and 0 again in October. The digestible solids (the amount that must be digested to produce satisfactory sludge) deposited were taken at a uniform quantity of 30 pounds per month, it being assumed that there were also received by the tank 30 pounds of undigestible organic matter and 40 pounds of mineral matter. The amount of digestible solids in the tank at the end of any month is the difference between the amount in the tank at the beginning of the month plus those deposited during the month, less the solids digested during the month, the latter being based on the temperature relation above referred to. The total sludge at any time consists of the undigestible solids contributed plus the digestible solids not yet digested, and less the sludge drawn up to that time. This calculation would indicate 840 pounds of sludge removed, out of 1,200 pounds reaching the tank, 360 having disappeared as the result of digestion.

Another computation indicates that a 5-degree decrease in temperature would result in an increasee in maximum sludge accumulation from 1.83 to 2.04 cubic feet per capita. If sludge is not drawn according to schedule and accumulates for, say, one month later in the spring than is assumed, the additional accumulation would be sufficient to infringe upon and possibly fill the entire neutral zone, and this at a time when gas production is at a maximum.

(To be concluded)

Underground Water Supplies of Yucatan

Yucatan, so remarkable for the remains of ancient cities and temples of an unknown Mayas civilization, is singularly lacking in natural supplies of water, particularly in the northern portion of the peninsula. It is a dry, scantily wooded, sandy plain, where the inhabitants have to depend on rain water caught in tanks and natural hollows, though it is evident that the

Mayas made use of a system of embankments, great reservoirs, and wells sunk to tap underground sources, a system which was worthy of a race that built mighty palaces of hewn stone, temples, houses, and pyramids splendid in structure, formed paved roads, and carried out works of art only to be rivalled in ancient Egypt for their vastness.

One of the most extraordinary of the wells of Yucatan is that from which the Indians of Bolonchen have drawn all their water for centuries. They enter a narrow opening under an overhanging rock, and follow it by the light of torches for some 80 ft. on a steep downward slant till a ladder is reached, which leads to the brink of a chasm 79 ft. deep. Many ladders lashed together and pinned to the face of the rock go down to the bottom of it; and as they are put in place when the wood is green, and the withes supple, and soon dry and crack, the descent and ascent of the water carriers sometimes results in an accident. If adventures come to the adventurous, the men of Bolonchen have more than their share of them every journey they make into the bowels of the earth for life-sustaining water.

Opposite the foot of the ladders is a large and lofty cavern, and on the far side of it lies a low narrow opening in the rock leading to an abrupt and steep descent, giving to another long ladder and a gorge. Here the torchlit trail rises slowly as it continues along this subterranean canyon for some 80 ft. to the foot of a ladder. One 9 ft. and another 6 ft. high are climbed to the mouth of a fissure, at the other side of which another ladder of 18 ft. is descended. A fifth, sixth and seventh are climbed down—each resting on lips of rock in the side of the chasm, till the mouth of the broken passage is reached, 200 ft. long.

An eighth ladder brings the Indians to a low stifling irregular tunnel in the stratum of rock, 300 ft. long. Along this the carriers crawl on hands and knees till the water hole is reached—1,400 ft. from the entrance under the overhanging rock, and some 500 ft. from the surface, as the plumbline hangs. Other like passages lead to six other subterranean springs, all of which go to supply the inhabitants with water during the five rainless months of the year.

That the Mayas were forced, at the zenith of their civilization, many centuries before the New World was discovered, to depend on cavern wells in various parts, is evident by the almost incredible underground watering place which supplied the ruined city of Xcoch. The roof of the low and crooked passages and stalactited caves remains blackened with the smoke of torches, and the track through the fissures and along the ledges of the deep chasms has been worn several inches deep by the feet of thousands and thousands of the water carriers of Xcoch. Xcoch that was a city when Thebes flourished and Tutankhamen was king in Egypt.

From "Water and Water Engineering" for Feb. 20, 1924.

Resurfacing Pennsylvania Roads*

Procedure followed by Highway Department in resurfacing old macadam roads with bituminous wearing surface.

After having decided that a given waterbound or bituminous macadam road should be resurfaced, the Pennsylvania State Highway Department first determines the depth of stone in the existing roadway by excavating test pits to the bottom of the stone in the center every 25 or 50 feet and on each side. Some of the roads have Telford base, others have received successive layers of stone for years back.

Following this examination, weak spots are rebuilt, subterranean springs and spongy places are remedied, and depressions are removed by grading, and finally the road is scarified to form a uniform cross-section. One of the most important points in this preparatory work is to have all pipes and drainage structures placed in advance of the actual surfacing so that the back-fill will have time to settle.

The base is brought to a true cross-section and grade by the use of a crown board, steel pins being driven every 10 or 20 feet and a cord stretched between them at the grade of the proposed ballast; and bearings about 4 feet wide and carried 1 to 2 inches above this line are built up as a guide to placing the new ballast. In bringing the ballast to surface, a straight edge laid longitudinally is used to keep all waves out of the road.

PLACING BALLAST

The ballast, which passes over a 1½-inch screen and through a screen with 3½-inch circular openings, is placed at the head of a section where it is to be eventually used, while the screenings are dumped on the side on a previously prepared shoulder. It has been the experience in Pennsylvania that screenings with a large percentage of dust give the best results, as this se-

*Abstract of paper before Highway Conference by W. A. Van Duzer, Equipment and Transport Engineer, Pennsylvania Department of Highways.

SCARIFYING ROAD.

cures a good filling of the voids and thus lessens tendency to ravel. The more "flour" there is in the screenings, the better they penetrate into the stone.

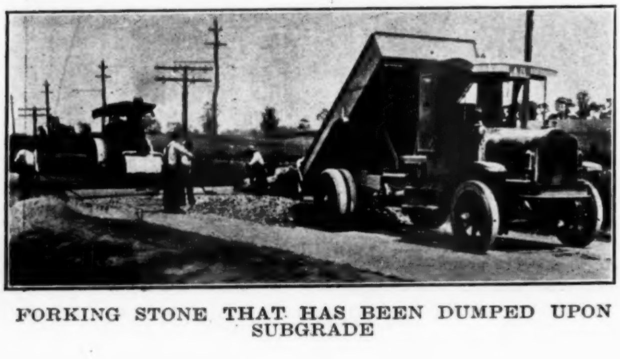
The ballast is not dumped upon the road, as this makes spots of uneven preliminary density and produces waves; but all stone is forked into place. The ballast is rolled with a 3-wheel, 10-ton power roller until the stone does not creep under the action of the roller. Screenings are then spread fanwise from a shovel and thoroughly broomed into the base from the center outward, rolling being continued meantime from the sides toward the center until all the voids are thoroughly filled. Water is then applied ahead of the roller and rolling continued until a grout is formed which flushes to the top and is spread evenly over the roadway by the action of the roller. A pushbroom is used to distribute the grout uniformly over the surface. It is desirable to allow the road to dry out before throwing it open to traffic.

CURING PERIOD

Following this surfacing, the road is cured by the action of traffic for one or two months. During this period the maintenance consists principally in sweeping to remove the caked or matted screenings from the edges and also to return to the center of the road the screenings which have been removed by the action of traffic, thus preventing the center of the road from ravelling. A mechanical broom or horse-drawn sweeper is used for this purpose. Where the traffic is exceptionally heavy, it may be necessary to add dry screenings, and occasionally during hot, dry weather to sprinkle the road. Under no circumstances should a road be rolled again, as this breaks the bond and destroys the value of the traffic-curing action.

FINISHING THE SURFACE

After a road has been cured in this way, the bituminous material is applied. The first application consists of low viscosity tar in order to obtain maximum penetration. Previous to applying this tar, the screenings must be removed by sweeping so that all voids will show between the ballast to a depth of possibly ¼-inch. The tar should be applied in two treatments, preferably by pressure distribution, the first being of approximately 1/3-gallon per square yard and the second 1/5 to ¼-gallon. The Pennsylvania experience has been that 1/3-gallon will penetrate the road, while the second application will remedy those spots which are not thoroughly bonded or are loosely bonded and will fill the voids and leave the ballast to take the wear. The material for this second application may be either high viscosity tar or asphalt, and the quantity should be just enough to fill the voids—the exact amount that will be required can be learned only by experience with the ballast and other features entering into this particular road.



FORKING STONE THAT HAS BEEN DUMPED UPON SUBGRADE

Pennsylvania roads which carry extremely heavy traffic are occasionally skid-chipped, which consists in applying from 3 to 10 pounds of chips per square yard. Hard stone chips ranging in size from ¼-inch to 1-inch, dustless and free from dirt, are used in a second treatment at the rate of 20 to 30 pounds to each gallon of bituminous material. In order to assist in forcing the chips into the bituminous material, they should be rolled with either a 5- to 8-ton tandem or a 10-ton macadam roller. The rolling can begin as soon as the chipping is completed, but equally good results are obtained if it is done from 24 to 36 hours later.

For best results, the road is given a third treatment using either medium viscosity coal tar, water gas tar, or asphalt, or a hot asphalt having an asphalt content of 88 to 95 and a penetration of 100. This is applied at the rate of .15 to ¼-gallon per square yard and requires from 30 to 40 pounds of chips.

After this treatment a road will probably bleed after being thrown open to traffic and must be watched carefully and chips applied to prevent the surface being picked up by wagon tires. If the treatment is made late in the Fall, the bleeding may not take place until warm weather occurs the following year, and re-chipping may then be necessary.

Where an old pavement is to be surfaced with bituminous macadam, the old base is prepared in practically the manner above described. After the road has been brought to a true cross-section, approximately 3 inches of stone, varying in size from 1½ to 2¾ inches, is spread and locked by rolling. The bituminous material is then applied at the rate of 1¾ gallons to 2 gallons per square yard. Stone varying in size from ⅝-inch to 1-inch is then spread uniformly and rolled. A seal coat of ½ to ¾-gallon of bitumen per square yard is applied and then ½-inch chips spread over the surface. The road is then rolled until it is properly bonded.

Cement Output in March

The production of Portland cement in March was 10,370,000 barrels, as compared with 9,880,000 barrels in March of 1923. However, the shipments were only 8,995,000, while last year they were 10,326,000. Shipment reductions were reported from every district except that including Virginia, Tennessee, Alabama and Georgia, which showed an increase of 50% over last year. The greatest decrease—40%—was reported for the district including Illinois, Indiana and Kentucky.

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A. PRESCOTT FOLWELL, Editor

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Highway Work in 1924

Figures received by us from officials of most of the states during the past month indicate that the amount of highway work, averaging the country as a whole, will be as great this year as in 1923, if not somewhat greater.

Figures were obtained from both state officials and county officials, the former being asked to state or estimate 1923 and 1924 expenditures throughout the state from all sources; while each county engineer was asked to give the totals from all sources in his own county. The total figures submitted by the county engineers show an estimated increase in highway expenditure this year over last of about five per cent., while figures of the state engineers indicate nearly twenty per cent. The latter are more complete and possibly more reliable. However, in some cases the figures probably include, in the amounts available for 1924, appropriations part of which will not be spent until 1925. Allowing for these, indications would seem to be that the expenditures anticipated for this year may somewhat exceed those of 1923.

One interesting feature shown by the figures is that the increases in expenditures are confined almost exclusively to the southern states and to those of the northern states that are most densely populated, including Illinois, Massachusetts, New York, Pennsylvania, Ohio, and Indiana. Exceptions are Nevada, the state engineer stating that nearly ninety per cent. more money will be available in that state this year than was spent last year; and Colorado, which expects to spend about fifty per cent. more this year than last.

This estimate parallels the one made in our February issue concerning expenditures for street improvements in the cities of the country, figures collected from city officials having indicated a probable ten per cent. increase for 1924.

The highway work done last year was, generally speaking, probably as great as could be handled advantageously by the experienced contractors and the labor available, and there probably will be little more labor to be had this year than last; so that if this year's total amount of work done equals that of last, there probably will be few dissatisfied among either contractors or highway officials.

Lighting Highways

Although there would seem to be no question about the advantages of lighting the principal highways of the country, some of which have been referred to by us and which are discussed in some detail in an article in this issue, the idea does not yet seem to have reached the point of actual performance to any very considerable extent. Among the questions sent to engineers of the county highways of the United States (the replies to most of which are published in this month's issue) was one asking how many miles of highways outside of the limits of cities had been lighted. Nearly five hundred counties were heard from, and of this number only ten stated that there was in their counties any lighting of roads outside the city limits. One of these was in Michigan, three in New York, one in Ohio, one in South Dakota, one in Texas (this being confined to two bridges on bad curves), one in Vermont and two in Wisconsin. Engineers of two of these counties have furnished some details concerning the lighting of highways which they report, which will be found in an article elsewhere in this issue.

As stated above, there would seem to be no

question as to the desirability of lighting the highways, directly to prevent accidents and indirectly to increase the night use of highways and thus diminish the day use and congestion. We do not know whether any figures have been prepared aiming to prove that there would be a financial saving in reducing accidents and in greater use of the highway which would offset the cost of the lighting, but a study of this point would be of interest, and a traffic study of the few sections of highway already lighted might furnish some data on which to base such a study.

As suggested in the article on another page, the wires used for furnishing current for the lamps would also undoubtedly be taken advantage of by the farmers as an opportunity for obtaining current for lighting their houses and for operating household and farm machinery; the profit from which use to the company or the county which owned the wires and the power might go a considerable way toward paying for the installation.

Paving Brick Standards

Paving brick manufacturers and users are to be congratulated upon the apparent success of the efforts of the Department of Commerce and the brick manufacturers to reduce to a minimum the number of standard types and sizes of vitrified paving brick. Beginning a few years ago with 66, the types and sizes have now been reduced to five, the latest reduction having been made at the meeting of the Permanent Committee on March 28th last.

Pavements made by combining Portland cement, asphalt or other binding material with local stone and sand have the great advantage over brick and stone block pavements that in many sections of the country freight has to be paid on only a small part of the material entering into the pavement, instead of on all of the wearing surface material. The fact that the yardage of brick pavements laid per year has doubled during the past few years would seem to indicate that this handicap is more than balanced in the minds of many engineers by the advantages of brick pavements.

The cost of such pavements has, however, been an undoubted handicap, and anything that will help to reduce the cost will tend to lighten such handicap. That the cost will be reduced to the manufacturer by the great reduction in the number of varieties for which he must provide machinery and of which he must keep in stock considerable surplus to meet the demands of the users, probably cannot be questioned. Also, it would seem certain that a large part of this saving will be passed on to the user, because it will be to the manufacturers' advantage to thus stimulate the use of brick in competition with lower-cost pavements.

The advantage, however, cannot obtain or will be greatly limited unless the users will co-operate by asking for only the sizes selected by the committee as standards. If users demand other sizes in sufficient quantities, manufacturers will probably supply them, but unless these additional sizes are entirely eliminated, the full benefit of the simplification of varieties cannot be realized by either manufacturer or user, and those asking for the non-standard sizes will be preventing a decrease in the cost of brick which would benefit themselves and all other uses of this material.

It is to be hoped, therefore, that all engineers and city and state highway officials, in ordering paving brick in the future, will ask for only the sizes recommended by the committee.

Two Prominent Engineers Die

Two engineers who have for years been prominent in municipal work have died recently—Nelson P. Lewis and Clinton S. Burns.

Mr. Lewis was 68 years old and had been chief engineer of the Board of Estimate and Apportionment of New York City from 1902 until he nominally retired from active work in 1920, although he continued in active connection with the Committee of the Russell Sage Foundation that has been studying a regional plan of New York City and environs. Mr. Lewis, after several years in railroad work, joined the engineering staff of the city of Brooklyn in 1884 and had been in the service of that city and Greater New York continuously since then except for a period of three years. In 1894 he was made the head of the Bureau of Highway Construction and Repair, which position he held until he was appointed chief engineer of the Board of Estimate.

Outside of this city he was well known as one of the leading developers of the modern science of city planning, as a past president and active member of the American Society for Municipal Improvements and as a director and vice-president of the American Society of Civil Engineers.

Mr. Burns was a member of the engineering firm of Burns & McDonnell of Kansas City, Mo., a firm which had for twenty-six years been active in municipal engineering work, specializing in waterworks and sewers. Besides being a member of the American Society of Civil Engineers and several waterworks and other technical societies, he was one of the founders of what is known as the Engineers Club of Kansas City. He was 53 years old, practically all of which had been spent in Iowa, where he was born, and in Kansas.

Activated Sludge in Ontario

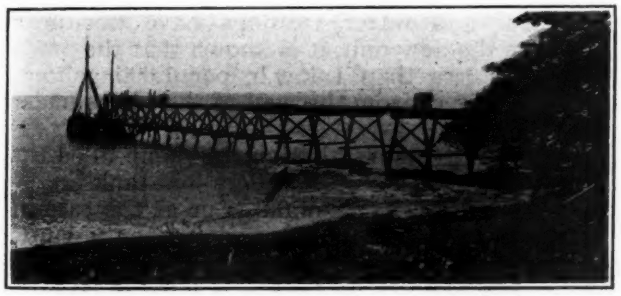
Considering the relative areas of Ontario and the United States, the activated sludge process seems to have been developed more rapidly in the former country. A recent report shows seven municipalities operating municipal activated sludge plants, these municipalities having a total population of 64,500, while the total rated capacity of the plants is 9,360,000 United States gallons per day. In addition, four other municipalities are planning to build activated sludge plants with a combined capacity of about eleven million gallons. In each of these cases the plant receives and treats all of the sewage collected throughout the entire municipality. In addition to these municipal plants, there are eleven small institutional plants.

Rock Drilling Under Water

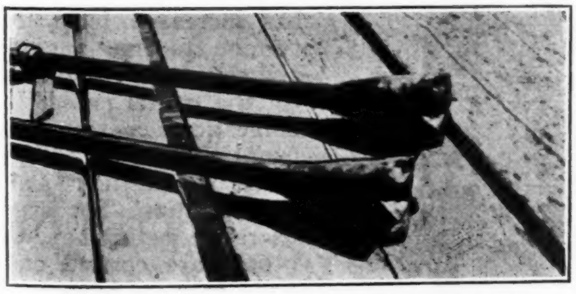
A diver, using special bits, drilled four-inch holes in seventeen to thirty feet of water.

A jetty at Shell Harbor, New South Wales, some time ago, was seriously damaged by a storm, about 200 feet of its outer end being carried away by the sea, and plans were immediately made for replacing it. The anchoring of the legs of the treststle bents to the rock bottom was to be effected by means of a 3½-inch steel pin projecting from the base of each leg into a hole drilled into the ledge. This presented some difficulties because of the exposed situation and the fact that the rock was a hard blue basalt.

At the suggestion of the director of a prominent engineering concern, a DDR jackhammer was tried for this purpose, being operated by a diver at depths ranging from 17 to 30 feet. Preliminary tests showed that the machine would operate satisfactorily under water and the next thing was to obtain suitable steel for drilling the hard rock. After some experimenting, a satisfactory drill was obtained by the use of six-pointed rose bits worked up from 3½-inch billets and welded on to standard drill shanks. Using these, the diver, John Farrugia, was able to drill 4-inch holes to a depth of 3 feet in 45 minutes, which was considered an excellent performance in view of the difficulties. By use of this equipment the holes were drilled at a much less expense than would have been entailed in rigging up a frame and employing a regulation submarine drill. The work was done by Frank Oberton as contractor.



JETTY AFTER RECONSTRUCTION.
New part extends from arrow to outer end.



BITS USED FOR SUBAQUEOUS DRILLING.

The jackhammer having proved so effective on this work, several No. 5 chipping hammers were purchased by Messrs. W. Solomon & Sons, contractors, of Sydney, to be used by divers in cutting 3 or 4 inches from the sill of a large graving dock at Sydney and proved very satisfactory for this work also.

Well Water System of Auburndale, Fla.

A plant of 800,000 gallons daily capacity furnishes soft water from one deep well for a small community.

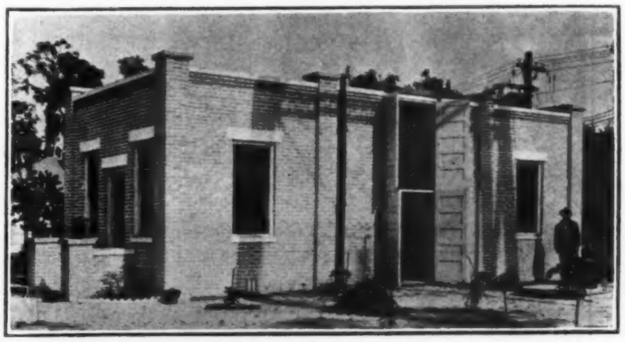
By H. C. Hewitt*

Auburndale, Florida, several years ago took its water supply from a deep well which terminated in the limestone formation underlying this part of the country. The well was poorly constructed and caved in after a few years of service, and a temporary station was located at a small lake adjoining the town, which, although it was inadequate and would have proven practically valueless in case of fire, served its purpose until a permanent and satisfactory waterworks could be constructed.

In the meantime investigations were made of the most reliable and efficient way of procuring underground water, and a contract was finally let to a firm which agreed to drill the well, install a vertical turbine pump and guarantee to produce a specific quantity of water for a certain price.

The new well differed from other wells in this locality in that, instead of stopping in the limestone formation, it extended to a sand stratum several feet below. The well was lined with a 10-inch casing to a depth of 136 feet and to the bottom of this casing was fastened a 40-foot strainer, set opposite the sand formation so that

*Water Superintendent of Auburndale.



AUBURNDALE PUMPING STATION.
Showing swinging doors for getting machinery into building. There is a trap door in the roof to facilitate handling pumps and motors.

the soft water from the sand stratum was obtained rather than the hard limestone water. The strainer was of special construction, consisting of a perforated standard pipe on which was wound a heavy galvanized wire of voussoir cross-section, the smaller width being next to the pipe, thus leaving a narrower horizontal slot at the outer circumference than at the inner. The purpose of this construction was to prevent sand grains from remaining between the wires and clogging the screen.

After the completion of the well the vertical pump was installed, the bowls or stages being set 30 feet below the water surface in the well. The discharge column and pump bowls were suspended from the base plate of the pump, which rests on a concrete foundation at the ground level. The centrifugal impellers which revolve inside the bowls are keyed to a steel shaft extending upward through an enclosed oil tubing. The pump shaft and the motor shaft are joined by a flexible coupling so that the pump and motor revolve as one unit, practically noiseless except for the hum of the 30 h. p. alternating current motor. To start the motor, it is only necessary to throw in the hand compensator and the pump is working at full capacity in about 30 seconds.

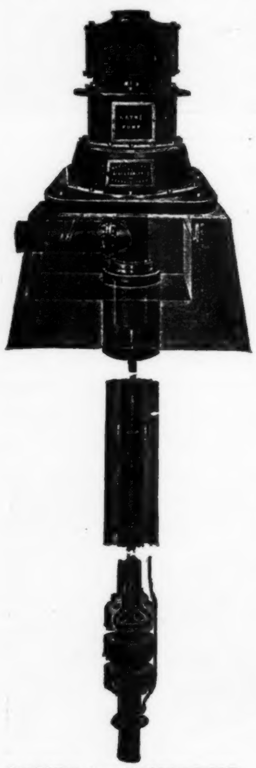
VIEW OF PUMP HEAD, AUBURNDALE.

When the pump was first put in operation it evidently pumped water which had been stored in the limestone stratum for several years, as it was extremely hard; but after a few months this supply was exhausted and the soft water from the sand stratum was obtained. The soft water has lately entered the well faster than it has been used, as the static level has raised several feet since the installation a year ago. As far as we have been able to determine, this is the only place in Florida where the water is obtained from a sand stratum; all other wells are terminated in the limestone and produce a hard water instead of the soft water which the citizens of Auburndale enjoy. On a recent test made by the Florida State Inspector the water was pronounced to be excellent for domestic purposes.

The vertical centrifugal pump discharges directly into the mains and into a 50,000-gallon tank elevated on a 75-foot tower, maintaining a pressure of 38 pounds on the system at all times.

A test of the reliability of our new station was made on Christmas night when a large packing house caught fire. Five streams were played on the fire and surrounding buildings for several hours at 40 pounds pressure, the elevated tank having been cut off and the pump discharging direct to the mains. Although accurate electrical and water readings have not been made on the new unit, it is known that the pump consumes less than 1 k.w.h. per 1,000 gallons, pumping direct from the well to the mains under pressure.

At the time of installation the pump filled the 50,000-gallon tank in 91 minutes or at the rate of 550 gallons per minute. A few weeks ago the tank was filled in 80 minutes, a rate of 625 g.p.m. (This was probably due to the opening up of channels in the water-bearing sand stratum, but indicates that there has been no material clogging of the screen by sand.—Ed).



GENERAL CONSTRUCTION OF PUMP.

In the short time which the new water works has been in operation, the number of consumers has increased from forty-nine to one hundred and seventy. In addition to the water used for domestic purposes, large quantities are used in the three packing houses and for irrigation. The larger users are metered and the others are carried on a flat rate. Apparently this plant can care for

Auburndale's present requirements in a most satisfactory manner and is of sufficient capacity to provide excellent service for future growth. The complete well water system was constructed by the Layne & Bowler Company, of Memphis, Tennessee.

Refuse Disposal in New Orleans*

The city of New Orleans produces an average of 380 tons of garbage and mixed refuse per day, which is slightly less than two pounds per capita. In collecting this, there are used 122 small dump carts, each with one mule and one man; 5 double dump wagons with two mules and two men each, and 25 trailers with two mules and two men each. The small carts are hired from private owners at $4 per day for cart and driver, while the double dump wagons and trailers are operated by municipal employees who receive $3 to $3.25 per day. The collection is under the supervision of five district superintendents.

The garbage from one district, amounting to about 75 tons a day, is taken to a receiving station, where it is loaded on cars and moved at night on the railroad to what is known as the Agricultural Street Dump; 17 city-owned cars equipped with bottom dump bins being used for the purpose. About 35 tons is brought to the same dump by carts from another section.

The garbage from another section, amounting to 86 tons daily, is hauled to a dump within its area four blocks long and two blocks wide, known as Silver City, because of the tin cans and other tin refuse so evident there. Thirty-five tons a day collected from a third district, and 24 tons a day from the house collections together with 50 to 75 tons of trade wastes in a fourth district, are carried to two more dumps within the city. Garbage from the section across the river known as Algiers, amounting to about 15 tons per day, is burned in an incinerator; while another incinerator destroys about 50 to 100 tons a day.

In 1915 the city authorities appointed a garbage investigation committee to recommend improvements in refuse disposal for the city, and this committee, after operating an experimental incinerator for a year and weighing and analyzing the refuse, determined the quantity produced in New Orleans, its composition, fuel value and moisture content during the several seasons of the year. It recommended constructing eight incinerators, each to serve a district having a radius of about 1 mile, with the idea of using one-mule carts with detachable metal bodies. Following the report of this committee, a Decarie incinerator was constructed in Algiers.

The study of the problem was continued by John Klorer, city engineer, who in 1921 recommended dividing the city into five districts instead of eight, with an incinerator in each district; the change in number of districts having been due to the fact that it had been clearly demonstrated that trailers with four times the capacity of one-mule dump carts would be much more economical, and that if these were used, the most economical haul would be that furnished by a district giving a maximum haul of two miles.

The three salient factors governing his program were: First Definition of the limits of each garbage collection district so that the maximum haul to the incinerator shall not exceed 2 miles. Second: Location of the incinerator not necessarily in the geometrical center of the district, but as near to the center of production as possible to achieve economical hauling results. Third: The erection of a type of incinerator that primarily shall be so sanitary in its operation and so free from objectionable odors or other faults that it will not be classed as a nuisance and, therefore, may be placed as near to its theoretically correct location as is practicable without incurring the disapproval of citizens in the neighborhood.

The five districts into which the city was divided (which do not include a considerable area that is yet sparsely built upon) were known as Districts A to E, inclusive, and the capacities of the incinerators recommended were 50 tons, 110 tons, 100 tons, 100 tons and 40 tons, respectively. In deciding upon these capacities, provision was made for growth of the district. For instance, in District D, for which a 100-ton plant was recommended, the present production of garbage is 51 tons daily, while the plant that was actually built has a rated capacity of 110 tons in 16 hours' operation. There is no reason why this plant could not be operated 24 hours with a corresponding increase in capacity, thus destroying more than three times the amount of garbage now being collected. In addition to the anticipated normal growth, the plants were given excess 24-hour capacity in order to permit any one plant taking on extra work should one of the other plants break down. In one of the other districts, however, where a 100-ton plant was recommended, the present collection is approximately 86 tons; but this is the most densely populated area of the city and little future increase is anticipated.

Mr. Schneider explained that a reduction plant was not considered feasible for New Orleans for several reasons, among them being the difficulty of obtaining separation of garbage by the citizens of that city; also the fact that New Orleans' garbage contains a very low percentage of grease, less than 3% having been found; but the outstanding reason being the additional expense of hauling the garbage to a reduction plant, which would have to be located at some remote place. Moreover, it was evident that even with a reduction plant in operation, one or more incinerators must be provided to destroy the combustible refuse other than garbage.

*Abstract of paper read before the Louisiana Engineering Society by Carl Schneider, superintendent of municipal repair plant.

Following this report, the City Council tentatively agreed to set aside several hundred thousand dollars to be used for the construction of three of the five incinerators, which three would have permitted the discontinuance of all the garbage dumps in the interior of the city (Mr. Klorer stated, in discussing the paper, that the city had agreed with the United States Public Health Service to eliminate all of the interior garbage dumps.) However, the state legislature of 1921 erased some $42,000,000 of taxable values from the personal tax roll, which greatly reduced the income of the city, and as a result they built only one of the three incinerators. The new incinerator was also a Decarie, similar to other plants of that make. It is housed in a well ventilated building with ample accommodation for crews in the shape of locker rooms, showers, etc. There are two incinerator units in the plant with a complete line of auxiliary equipment.

OPERATION OF THE INCINERATOR

Refuse is delivered to the incinerator in trailers, each carrying two steel containers having a capacity of 2 cubic yards each. These trailers are unloaded by an overhead electric traveling crane, the refuse being dumped either directly into the furnace hopper or else stored in the containers on the charging floor. Empty containers are returned to the trailer, which stands on a platform scale by which the weight is taken and recorded of each loaded and unloaded trailer, thus giving the net weight of all the refuse received.

As a rule, the men, in collecting the refuse, separate large cans, old oil heaters, etc., from the other material and throw them into one of the two containers on the trailer. When the other container becomes practically filled with small refuse, they place on top of it these large incombustible materials and fill the second container. Before the trailers are weighed on the platform scales, these large pieces of incombustible matter are thrown off on to a trailer which is located conveniently for the purpose, and which hauls them to the dump. All small cans less than 10 to 12 inches in diameter are dumped into the basket grate along with the other refuse.

After the material discharged into the furnace has been reduced to ashes and clinkers, these are dumped into an ash pit periodically, generally about every four hours. The ashes are pulled by hand from the ash pit into special cars, by which they are dumped into a container conveniently located for being handled by the crane. These containers, when filled, are removed from the plant by motor trucks. The ashes are at present being used for covering the top of the dump at the Dublin Street Canal.

The steam generated is used for operating the plant auxiliaries and for generating electricity for light and power. When more steam is generated than is needed for this purpose, part of the surplus is piped to the municipal repair plant, where it is used for heating oil and asphalt; the remainder being allowed to escape through safety valves. While steam is used for operating the plant auxiliaries and around the municipal repair plant, it cannot be relied upon, as the amount produced varies with the character of the garbage and weather conditions, commercial fuel being required even to secure complete combustion of the refuse during rainy weather. Evaporation is reported to have averaged 0.35 pounds per pound of refuse charged, which is low, as it is not uncommon for city refuse to evaporate one pound of water per pound of refuse burned.

An official test of the plant of twelve hours' duration was conducted on Nov. 24th, under normal conditions, but with a rather inexperienced crew. The plant developed a capacity of 6.5% above the rated capacity of 7 tons per hour. The cost of incineration, based on rates of pay specified in the contract, amounted to 45 cents per ton. "No objectionable features developed during the time that the plant was in operation, and guaranteed performance was realized in all respects." During the year 1923, the city operated the plant at a rate averaging its rated capacity, but frequently at a much greater rate, and the actual cost of incineration varied from 80 cents to 95 cents a ton, or nearly double that shown at the test. "Reasons for the higher cost of incineration when operated by the city are: (1) higher scale of wages paid than was specified; (2) larger crew than recommended and used by contractor; (3) variation in quantity of garbage received from day to day; (4) incidental expenses not included in official test results—namely, fuel, repairs, overtime and Sunday work for cleaning; (5) refuse received being consumed before expiration of working hours."

The large amount of moisture in the refuse as received at the incinerator during rainy weather disadvantageously affects the performance of the plant, as does also excessive amounts brought to it on Saturdays and Mondays and the insufficient facilities for handling ashes. In future plants it is hoped that more satisfactory means of removing ashes can be provided. At this plant the crane which handles the ashes also handles the refuse and frequently is not able to attend to both satisfactorily. An automatic skip hoist and ash hopper are proposed as a substitute. The refuse of New Orleans seems to be unusually high in ash content, ashes, tin cans and other incombustibles composing about 25% by weight of the total refuse received.

This plant cost $90,000 for furnaces and equipment, $5,000 for stack and $45,000 for the building—a total of $140,000.

In comparison with the cost of about 90 cents for disposing of the refuse in the incinerator, it was reported that burning the refuse in the open air at the Agricultural Street dump cost $1.45. At the dump the refuse is taken from the belt railroad by a locomotive crane and spread by it in such a manner on the fires as to facilitate combustion.

The cost of open air burning includes 43 cents

per ton to cover payroll and operating costs at the receiving station, 24 cents per ton for hauling by the belt railroad, and 78 cents per ton to cover the operating cost at the dump. The cost of collecting the garbage is approximately $2.00 a ton.

Electric Trucks for Refuse Collection*

By Rodney K. Merrick

The heralded success of the installation of electric trucks by the salvage departments of the various cities in England has provoked considerable comment in this country as to the possible wider application of the electric truck to streeet cleaning and refuse collection work here. There can be no doubt that too little attention has been paid in this country to the fact that the electric truck has its own fields of operation, just as the gasoline truck and the horse-drawn vehicle have theirs. Within that field it is not even remotely approached in service and economy by any other type of delivery equipment. A careful study of the whole field of transportation reveals the part of the field which properly belongs to the electric truck.

This field has been variously defined by different authorities. H. Cook, chief inspector, Salvage Department, Birmingham, England, has gone on record to the effect that the electric truck is the most economical for refuse collection from one and a half miles upward. Recent experiments with 5-ton electric trucks in Mr. Cook's home city in England indicate, however, a possibility that the horse may be now outclassed even for the shortest hauls.

The daily mileage usually will vary on electric trucks from 12 to 13 miles per day up to, in an exceptional case, anywhere from eighty to a hundred miles. It depends entirely upon the character of the work and the conditions under which the truck will operate as to the possible mileage. However, under normal conditions it is generally figured that an electric truck operates to its best advantage at from 25 to 45 miles per day, and when the daily mileage gets above 45 miles per day the conditions surrounding its operation should be studied very carefully before decision is made to recommend an electric for the work involved.

One large operator in Washington, D. C. reports that their electric "has covered as high as 45 miles in a single day. Electric trucks are much faster in city work than gas trucks or horses and will save a considerable amount of time in route work."

Another operator in Newark, N. J., reports that "our routes vary in length, the longest being a trifle over 30 miles daily, although in a test made with one of our ¾-ton trucks with standard size battery, we covered slightly over 60 miles on one charge of the battery and about one-third the distance was over some of the worst hills in this locality."

The field of the electric truck may be said, therefore, to be limited only by the fact that it must be able to put in where the battery may be re-charged. The mileage obtained from one charging of the battery may be increased and the field of operation extended when facilities are provided for boosting or exchanging the battery.

These haulage qualifications of the electric truck fit well into the general scheme of refuse collection as carried out in this country today. In using the general departmental title of refuse collection, I have in mind three distinct divisions of work: rubbish, garbage, and ash removal. As a rule, the removal of any one of these items in a large city makes necessary the establishment of one or more loading stations, or central stations, as they are called in some cities.

The electric truck is economical for loading station work with this route character, as there are a large number of collections on the routes leading to such stations. It has been estimated that the number of collections in the average city block equals one hundred, allowing for fifty houses on each side of the street, necessitating much frequent starting and stopping.

The number of movements saved by the driver in a year on the average collection route because of the greater ease in starting and stopping an electric truck as compared to the gasoline trucks has been figured by one user as running well into the hundreds of thousands. The consequent saving in the driver's time and energy should be an important item to the superintendents of the street cleaning divisions in our various municipalities.

Of even greater importance is the amount of wear and tear on the truck itself that is saved. A gasoline truck is superior when used for long distance work, for long collections with few stops, such as sometimes obtain where the block system of collection is used, and for any kind of high mileage work; this is admittedly the field of the gasoline truck. Gasoline consumption is increased by frequent starting and stopping, and tire wear and mechanical upkeep are greater. Statistics compiled by the Postmaster General's office show that where there is frequent starting and stopping the gasoline consumption is three or four times as great as on long hauls with few stops. The electric truck on the other hand, starts smoothly and instantaneously with the positive action of the electric motor, so that the wear is reduced to a minimum. The motor stops when the truck stops.

The electric truck has been aptly described as simplicity itself. By that I do not mean that it is merely a frame, motor, controller and driving gears thrown together so that it will run when there is a flow of current from the battery to the motor. An electric truck by virtue of the exacting work for which it is designed has to be built with the greatest attention to structural details to guard against loss of efficiency and consequent loss of mileage and work done.

*Published through the courtesy of the electrical industry's Joint Committee for Business Development

It is not surprising, therefore, to find that the consensus of opinion among electric truck users is that depreciation is not nearly as rapid on electric trucks as on gasoline trucks. Those users from whom opinion was sought were able to arrive at their decision with complete fairness because in many instances they were either operating gasoline trucks on their long, non-stop routes, or formerly had such trucks in service before purchasing electrics.

Such an authority as E. E. La Schum, superintendent of motor vehicles of the American Railway Express Company, which owns and operates a fleet of approximately 1,300 electric trucks, has gone on record as saying that the useful life of an electric truck is over 15 years. In other words, the annual depreciation of his electrics on that basis is 6⅔ per cent.

On this phase Mr. La Schum recently elaborated by stating that "as a matter of fact, the electric being manufactured today should, I believe, be economical for as long as twenty years. There are comparatively few wearing parts. Since they are generally rotating instead of reciprocating parts, and since lubrication of all wearing parts is positive, by the simple method of replacing a few of the worn parts, I see nothing to hinder continuous operation for a very long period. While these electrics are being operated for a very long period the users do not have to invest heavily in parts or repair materials."

Electric trucks have so simple a control system that they are as easy to drive as a horse; they have all the speed that the law permits and this speed is inherent in the truck—not subject to the whims and speed mania of the operator; they start instantaneously, run smoothly and with constant speed.

They have a short turning radius, making them easy to handle in the garage, at the loading platform or in narrow streets. Obviously, the fire hazard in electrically driven trucks is low and ordinarily the danger of theft is not even considered. This has resulted in a general reduction of insurance rates covering electric trucks.

In charging equipment also there have been radical improvements. Where it was formerly necessary to watch the charging operation to guard against over-charging or too speedy charging, now charging equipment can be made entirely automatic. This lessens the labor connected with battery-charging and insures long life for the battery.

It is a far cry from the old type of battery of questionable durability to the present day battery of high efficiency and long life. It is of the utmost importance that users and prospective buyers of motor truck equipment fully realize the scope of electric truck and battery improvement in the last ten years. It is no more fair to judge present day electric equipment by that of ten or fifteen years ago than it is to judge the present gas truck or car by the performances of the gas vehicles of 1910.

Every year I find users who want to lay up their electrics with the first heavy snow; the greatest problem is to get both owners and drivers to use their trucks in the way that they will get the most out of them. To begin with, they should not underestimate the ability of an electric truck in snow.

Back in the winter of 1914 a severe snow storm struck the eastern part of the country. The blizzard raged off and on from February 22 to March 8. On March 2 the snow was more than 22 inches deep and drifting badly. Vehicle traffic was completely paralyzed; most trucks did not venture out.

This storm marked the first severe test for a new fleet of electric trucks owned and operated by the Curtis Publishing Company. The trucks, twelve in number, were placed in service late in 1913 and their performance during the first winter was watched with interest.

The way the trucks behaved was beyond the expectations of the owners. During the storm the fleet hauled a daily average of over 485 tons. On March 2, with the snow 22 inches deep, a total of 462 tons was hauled. During this period out of a possible 1,980 truck hours, the total delay for repairs was less than 45 minutes, a working efficiency for the entire fleet of 99.96 per cent.

There are days in winter when every type of vehicle is handicapped in getting over the road, electric trucks included. But experience over a period of many years has demonstrated that electric trucks, with reasonable judgment on the part of the shippers and drivers, get through many times when every other type of equipment is held up.

Primarily, the secret of getting electric trucks to cover their normal route in snow is to conserve the current as much as possible. Every ampere-hour wasted means a reduction in the possible mileage. The electric will not get stuck if care is exercised and discretion is employed in the use of current, for as long as the battery is not totally discharged the truck will plow through almost any amount of snow. There are "tricks to every trade" and there are simple things which drivers can do easily and with no trouble to themselves which will give them maximum service from their electrics.

The North Carolina Road Building Demonstration

Plans for the road show to be given in June by the North Carolina State Highway Commission are developing. The date has been set as June 3 to 10 inclusive. The South and Central American delegates are to reach Raleigh on June 4, inspect the Highway Commission's headquarters and large garage, and be taken to Greensboro, where the road-building and maintenance demonstration will be in full swing at the Fair Grounds, near the city. The visitors will also be taken to see actual construction work on practically every type of road (on which up-to-date machinery will be in use) near Raleigh, Winston-Salem and High Point, and between there and the large concrete bridge over the Yadkin River, and between Charlotte and Asheville and Sylva, returning to Asheville and disbanding June 10.

Curing Concrete Roads

Investigations and experiences in the use of calcium chloride by the Illinois Division of Highways.

In a paper read a few weeks ago before the American Roadbuilders Association, H. F. Clemmer, engineer of materials of the Illinois Division of Highways, described an investigation conducted by the Bureau of Materials concerning the use of calcium chloride for reducing the period for curing concrete roads, required under present methods, and also the various effects of the material upon the concrete.

He stated that it had generally been proven that "calcium chloride, when used in the proper amounts, does accelerate set and secure the same strength at the end of fourteen days as can be obtained from the use of the various wetting methods in twenty-eight days."

Concerning the theory of this, Mr. Clemmer said that, while the action of the chemical is dependent chiefly upon its hygroscopic properties and the resulting ability to attract moisture from the air, it is thought that, in attracting it from the concrete also, it produces minute capillary channels in the concrete, into which the calcium chloride is in turn drawn and so penetrates the concrete for a considerable depth. The tests demonstrated that this penetration took place within twelve hours.

Some have objected to the use of calcium chloride, under the belief that the surface of concrete that had been treated with it frequently scales and becomes mushy. The Illinois Department has had experience in treating with calcium chloride over 1,000 miles of concrete pavement, and found no more serious cases of scaling on concrete cured with the chemical than on that cured with wet earth or ponding. In fact, investigation indicated that excess tamping or belting were the most serious causes of scaling.

Primary interest being concerned with the strength obtained in fourteen and twenty-eight-day periods, the greater number of specimens were tested at those ages; but others were tested at sixty days, ninety days, six months, one year and two years.

The tests consisted in determining the modulus of rupture of the various specimens tested. Tests were made on slabs 8 inches by 12 inches by 30 inches, pavement conditions being duplicated as closely as possible during seasoning. Some of the slabs received no treatment, some 2 inches of dirt wet for three days, others the same wet for seven days and still others wet for fourteen days, while other slabs received from one to three pounds of calcium chloride per square yard, applied after 10 hours and after 24 hours. Precautions were taken to eliminate personal equations and others common in cement testing laboratories.

These tests appeared to demonstrate that, when cured with calcium chloride, concrete reaches as great strength in fourteen days as it does in twenty-eight days when wet earth is used.

Tests were also made using concentrated solutions of calcium chloride instead of the dry chemical, but the latter was found to be far superior.

The author stated that the property of calcium chloride of "maintaining the moisture content of the concrete at a higher percentage during the first forty-eight hours leads to the belief that the chemical serves to prevent the formation of transverse cracks caused by shrinkage. General observation indicates that fewer transverse cracks occur in concrete pavements cured with calcium chloride than in those cured by ponding or wetted earth. This is being definitely investigated in Illinois at the present time."

Specimens that had been treated with a surface application of dry calcium chloride at a rate equivalent to 10 pounds per square yard of surface indicated slight puffing due to this excessive use of the chemical. It was noted, however, that the tensile strength of these briquettes at the age of 28 days was not affected by the excessive amount of chemical. Contractors are cautioned, however, against using excessive amounts and are instructed to break up all lumps and spread the material evenly.

Other tests were made to determine the rate of wear of surfaces that had been cured differently, two heavy weights being drawn in a circle by a revolving arm while standard abrasive material flowed at a uniform rate just in front of the weights. Under this test, a surface that had been treated with 2½ pounds of calcium chloride showed an almost imperceptible wear of .024 inch, while a surface which had not been so treated showed a wear of 0.2 inch under the same number of revolutions.

As a result of these favorable tests, the Illinois Division of Highways determined to permit the use of this material, and about three-quarters of the total mileage constructed in 1923 was cured in this manner. A general circular has been issued containing the following instructions for surface application of calcium chloride:

"Calcium chloride may be used in connection with curing of pavements, taking the place of the usual curing with earth and water, or the curing with water by what is known as the 'ponding method.' Two and one-half pounds of flaked or granulated material (the flaked is preferred as it is more easily distributed and less easily removed by wind or rain) shall be applied to each square yard of pavement and it shall be distributed uniformly over the surface of the finished pavement by means of a mechanical drilling device or by the use of shovels and long-handled brooms. The material shall not be spread upon the pavement until the latter has thoroughly set—ordinarily from 6 to 8 hours after laying the pavement. Care shall be taken that the material is uniformly spread and if, in the opinion of the engineer, a uniform distribution is not obtained from the shovels, a thorough brooming shall be required. All lumps shall be broken up and uniformly distributed over the surface.

"Calcium chloride shall not be applied during rain and experiments have definitely determined that if a rain follows the placing of the calcium chloride after a period of two or three hours there will have been enough absorption of the calcium chloride by the new pavement preceding the rain so that there will not be required additional applications of the material.

"Although the water line for curing of pavements with water may be omitted where central mixing plants are operated and calcium chloride is used in curing, nevertheless the general specifications with regard to wetting of subgrade and the general specifications with regard to placing of burlap on the freshly deposited concrete and wetting of burlap shall be strictly enforced. The use of calcium chloride for wetting the subgrade will not be permitted. When calcium chloride is used in curing, the sides of the concrete pavement shall be banked with earth as soon as the forms are removed."

It was apparent that incorporating curing agents in the concrete would be more convenient, and the use of the proper amount could be more accurately controlled, but preliminary tests indicated that greater strength was secured by external application. However, it is probable that further tests will be made on the incorporation of calcium chloride with the concrete when mixing.

State and County Highway Statistics

Replies to questionnaires received during the past month from nearly five hundred county and state officials. Money spent and available; kinds and amounts of pavement laid; force account work, and other highway details.

The tables on the following pages summarize replies received through questionnaires from nearly five hundred county officials throughout the country and also the state highway officials of the several states. It is believed that the column headings of the tables are self-explanatory, but in order to enable those who may study the tables to more intelligently interpret the figures, we give below the exact form of the questions to which these figures were given as replies.

The questions asked of the county engineers were as follows: "How much was spent in your county in 1923, under county or state supervision, from county appropriations? From state appropriations? From federal appropriations? From other appropriations?" "How much money is available (county, state, federal and other funds) for highway work in your county in 1924?"

"Please give below the amount, in miles or square yards, of each kind of road improvement done last year under state or county supervision and the total cost of each," this being asked for the following kinds of improvement: Grading, earth surfacing, gravel, plain macadam, bituminous macadam, bituminous concrete, cement concrete reinforced, cement concrete not reinforced, brick, and other kinds.

"Do the costs given above, except the first, include grading? Do they include bridges and culverts?"

"How much of the work that you contemplate doing in 1924 do you expect to let to contractors? How much do you expect to do with county or other public employees?" "How many of your culverts will be of concrete poured in place? What material will be used for culverts not built in place?" "If your concrete roads are reinforced, what kind and weight of reinforcement will be used?"

Of the state highway engineers the following questions were asked: "How much federal aid was spent by your state in 1923? How much was furnished by the state for highway work? How much was furnished by counties, towns or other subdivisions of the state? How much federal aid is available for 1924? How much will be furnished by the state in 1924? How much by counties, towns or other subdivisions?"

"Please give below the amount (in miles or square yards) of each kind of road improvement done last year under state supervision, and the amount contemplated for 1924," this being asked for the following kinds of improvement: Grading, earth surfacing, gravel, plain macadam, bitu-

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STATE HIGHWAY WORK—FINANCIAL

	1923			1924		
State	Federal Aid	Furnished by State	By Counties, Towns & Others	Federal Aid	Furnished by State	By Counties, Towns & Others
Colorado	1,300,000	4,150,000	Not known	2,950,000	5,165,000	Not known
Delaware	379,256	1,459,889	1,474,983	605,718	1,516,900	1,100,000
Florida	931,637	3,060,682	560,095	....	6,922,633[a]	....
Illinois	....	25,612,478[a]	None	....	28,000,000	....
Indiana	2,965,106	2,140,901	Not known	1,692,437	2,445,755	Not known
Iowa	2,569,634	4,590,854	7,924,149	3,230,706	4,335,000[e]	4,460[e]
Kentucky	1,574,547	4,588,603	799,425	1,450,000	4,850,000	750,000
Maryland	554,541	1,500,000	1,031,733	640,629	1,500,000	750,000
Massachusetts	1,250,000	6,664,432	1,767,699	950,449	7,670,700	2,000,000
Michigan	2,000,000	10,000,000	3,000,000	3,431,713	10,000,000	2,500,000
Missouri	5,247,230	15,000,000	832,064	3,600,000	10,000,000	None
Montana	747,000	86,000	452,000[b]	1,000,000	80,000	520,000[b]
Nebraska	....	....	....	1,900,000	1,500,000	400,000
Nevada	1,287,061	377,362	449,095	2,780,244	525,736	620,441
New Hampshire	365,625	2,060,000	750,000	....	....	....
New Jersey	618,499	16,500,000	....	800,000	17,000,000	....
New Mexico	1,365,000	....	....	....	3,500,000[a]	....
Ohio	4,102,536	9,658,608	9,000,000	3,000,000	10,000,000	7,000,000
Pennsylvania	1,206,213	21,949,415	9,659,800	5,475,362	45,816,332	5,941,355
Rhode Island	300,000	1,700,000	60,000	400,000	2,000,000	....
South Carolina	1,173,543	902,291	3,452,727	1,800,225[c]	1,000,000	4,000,000
South Dakota	1,400,000	2,223,000	4,600,000	1,050,000	1,997,000	4,900,000[a]
Utah	1,024,027	None	971,642	2,025,000	None	787,600
Vermont	300,000	630,000	262,000	....	1,100,000[a]	....
Washington	273,551	2,781,677	1,266,790[d]	1,103,710	....	....
West Virginia	600,000	10,000,000	None	....	10,000,000[a]	....
Wisconsin	1,705,987	2,491,000	....	600,000	785,000	750,000
Wyoming	1,084,215	2,233,348	....	1,026,374	2,000,000	....

[a]—Includes Federal Aid and all other available funds. [b]—On Federal Aid projects only. [c]—Also $1,061,237 if new law passes. [d]—For work under state supervision. [e]—Estimated.

HIGHWAY FUNDS

State and County	Amount spent in County in 1923 from— County approps.	State approps.	Federal approps.	Other approps.	Total amount available during 1924
Alabama:					
Lee	None	....	$85,000(a)	None	$150,000
Montgomery	$205,498	....	....	....	350,000
Pike	65,000	None	None	None	60,000
Arizona:					
Maricopa	2,968,000	....	....	....	303,500
Arkansas:					
Conway	100,000	....	41,000	....	None yet
Hempstead	15,000	....	25,000	30,000	60,000
Newton	4,000	1,300	....	....	8,000
Pike	....	....	....	....	21,000
Poinsett	155,000	None	117,000	....	None
California:					
Fresno	1,250,000	....	....	....	500,000
Mono	2,200(b)	....	....	....	40% Co. funds
Plumas	92,000	....	....	....	90,000
San Joaquin	....	....	....	416,362	275,000
San Luis Obispo	200,000	....	....	....	500,000
Sutter	94,845	13,837	....	....	600,000
Colorado:					
Cheyenne	94,354	42,719	None	51,634	65,000
Lake	7,500	7,500	None	None	15,000
Mesa	114,093	96,643	55,000	3,108	368,474
Rio Blanco	36,033	35,300	17,500	....	33,000
Florida:					
Flagler	60,000	150,000	None	....	50,000
Broward	250,000	....	....	40,000	250,000
Jefferson	50,000	None	None	....	150,000
Santa Rosa	107,400	None	13,000	15,000	113,000
Georgia:					
Bibb	83,000	None	75,000	None	200,000
Walker	85,000	10,000	35,000	....	120,000
Idaho:					
Boise	36,000	None	120,000	None	183,000
Clearwater	45,000	15,000	55,000	130,000	125,000
Idaho	....	132,600	167,400	....	75,000
Nez Perce	56,000	None	None	....	Uncertain
Power	80,000	10,000	20,000	....	60,000
Twin Falls	70,621	None	None	None	46,271
Illinois:					
Adams	85,000	5,000	....	10,000	105,000(b)
Bond	25,000	None	None	None	6,000
Brown	16,000	....	....	....	50,000
Calhoun	30,000	....	....	....	30,000
Carroll	20,000	149,000	100,000	....	290,000
Cumberland	44,000	....	....	5,000	Uncertain
Douglas	159,904	....	....	....	176,000
Fayette	34,000	....	....	....	34,000
Fulton	521,000	350,000	....	171,000	750,000
Hancock	30,000	....	....	....	40,000(c)
Jasper	6,000	45,000	None	15,000(d)	225,000
Kane	200,000	....	....	....	800,000
McDonough	48,931	....	....	....	....
Macoupin	40,000	....	....	....	106,000
Marion	20,000	(e)	....	....	28,000
Mason	None	104,000	....	....	19,000(c)
Massac	16,000	130,000	65,000	50,000	400,000
Monroe	30,000	None	None	None	37,000
Peoria	208,092	135,000	None	255,977(d)	485,934
Illinois (Continued)					
Pulaski	....	80,000	25,000	50,000	50,000(c)
Putnam	10,000	None	None	....	9,800
Richland	42,400	94,500	94,500	State road	100,000
Schuyler	75,000	310,000	225,000	....	1,200,000
Stephenson	59,999	650,000	....	....	170,000
Washington	36,162	None	None	None	27,000
White	20,000	100,000	....	....	350,000(f)
Whiteside	....	74,924	....	....	30,000
Will	170,000	....	....	....	120,000(g)
Winnebago	440,343	....	....	....	125,915
Woodford	....	....	....	....	68,000
Indiana:					
Dubois	368,500	None	None	None	200,000
Franklin	50,000	None	None	None	100,000
Howard	8,500	None	None	....	75,000
Jackson	65,000	140,000	75,000	10,000	150,000
Jennings	....	None	....	....	99,300
Newton	157,000	None	None	....	75,000
Posey	....	None	None	....	Very little
Spencer	500,000	....	....	....	35,000
Vigo	557,000	141,000	115,000	....	5,700,000(c)
Warrick	50,000	225,000	112,500	250,000	100,000
Wayne	....	....	....	264,000	....
Iowa:					
Adair	184,084	26,286	90,000	....	235,000
Adams	45,000	70,000	....	....	50,000
Benton	119,000	....	....	....	112,000
Black Hawk	104,000	523,000(h)	....	....	1,125,000
Boone	200,000	25,000	....	....	175,000
Bremer	28,600	40,000	10,000	....	112,000
Buchanan	64,000	83,000	17,000	....	110,000
Buena Vista	60,000	66,000	14,000	....	140,000
Cedar	....	281,000	....	....	40,000
Cerro Gordo	145,000	46,000	....	....	140,000
Chickasaw	75,000	65,000	20,000	....	125,000
Clarke	150,000	75,000	25,000	50,000	70,000
Crawford	....	....	....	....	400,000
Clayton	300,000	125,000	25,000	150,000	175,000
Decatur	35,000	100,000	....	....	130,000
Dickinson	....	30,000	....	....	60,000
Des Moines	70,348.31(h)	....	....	....	Only maintenance
Dubuque	50,000	150,000	None	....	90,000
Emmet	86,076	20,933	None	None	....
Fayette	266,000	....	....	....	261,000
Floyd	203,774	30,000	None	None	127,000
Greene	200,000	80,000	20,000	100,000	800,000
Grundy	70,000	80,000	....	....	150,000
Guthrie	77,000	90,000	30,000	None	80,000
Hamilton	100,000	90,000	....	....	200,000
Hancock	45,000	30,000	20,000	....	100,000
Howard	15,000	45,000	....	....	151,000
Jones	28,000	65,000	15,000	....	105,000
Kossuth	60,000	120,000	28,000	None	150,000
Lee	....	158,000	....	....	110,000
Linn	250,000	50,000	None	None	100,000
Lucas	37,268	24,539	....	....	106,711
Lyon	105,000	....	....	....	110,000
Madison	87,939	18,826(h)	....	....	235,000
Marion	86,686	80,000	....	....	216,000
Mills	76,396	18,129	None	None	40,000
Monona	48,937	450,101	....	....	185,000
Monroe	35,000	60,000	10,000	....	160,000
O'Brien	93,000	14,000	....	....	180,000
Osceola	50,000	60,000	....	....	100,000
Palo Alto	79,902	12,665	None	None	110,000
Pocahontas	62,416.45	58,382.74	14,481.82	15,000	255,000

HIGHWAY FUNDS (Continued)

State and County	Amount spent in County in 1923 from— County approps.	State approps.	Federal approps.	Other approps.	Total amount available during 1924
Iowa (Continued)					
Poweshiek	125,000	....	....	....	125,000
Ringgold	57,000	160,000	14,000	....	150,000
Sac	110,000	105,000	20,000	None	185,000
Scott	383,861	730,127(l)	....	....	1,332,000
Shelby	120,000	35,000	....	....	200,000
Tama	120,000	300,000(h)	....	None	50,000
Union	60,000	40,000	....	....	150,000
Van Buren	70,000	50,000	30,000	....	150,000
Warren	30,000	42,000	....	....	206,000
Webster	97,825	110,000	....	....	75,000
Kansas:					
Barber	19,114	None	None	None	30,000
Barton	75,000	3,200	9,000	....	120,000
Bourbon	130,000	None	75,000	18,000	....
Brown	120,329	35,302	35,423	....	130,000
Butler	205,000	86,000	63,000	....	429,000
Cheyenne	74,000	7,500	15,000	....	45,000
Clay	47,000	....	....	....	52,200
Cowley	120,000	None	None	None	....
Crawford	247,500	....	....	....	250,000
Doniphan	134,451	....	....	304,174(h)	400,000
Douglas	69,376	50,000	78,915	14,534(k)	128,712
Ellis	56,000	....	....	....	126,000
Finney	58,000	15,000	None	None	100,000
Ford	59,044	....	....	....	138,000
Geary	67,826	....	....	....	76,054
Gray	39,226.39	....	....	....	88.606
Harvey	....	....	....	....	68,000
Jackson	70,000	None	23,470	None	72,000
Kingman	75,000	None	None	None	57,000
Lincoln	33,486	None	None	....	65,000
McPherson	83,000	None	None	None	84,000
Marion	80,000	25,000	20,000	....	200,000
Miami	67,138	....	....	57,739(d)	135,000
Montgomery	156,000	....	72,500	....	400,000
Norton	....	....	....	....	150,000
Pawnee	46,750(c)	38,645	76,460	23,480	263,000
Rawlins	34,501	12,851	25,702	34,501	11,500
Reno	285,731	None	236,111	....	225,000
Republic	78,000	....	23,000	....	90,000
Rooks	9,760	None	None	None	90,000
Sheridan	45,000	....	....	26,000	10[illegible],000
Sumner	116,589	11	601,790	129,434	126,058(c)
Thomas	23,023	....	....	....	65,500
Wabaunsee	25,000	None	None	None	50,000
Wilson	150,316	None	90,160	None	35,000
Kentucky:					
Allen	18,700	2,500	....	....	384,000
Boyle	40,000	15,000	None	None	60.000
Carroll	5,000	None	None	None	150,000
Clark	60,000	None	None	None	400,000
Corbin	45,000(c)	....	....	....	450,000
Crittenden	15,000	50,000	50,000	....	....
Daviess	119,000	None	None	None	100,000
Fayette	269,000	20,000	....	....	170,000
Fleming	35,000	None	None	....	32.000
Kenton	124,900(c) 202,000(f)	None	None	B'ds 500,000 Tax 130,000	380,000
Leslie	30,000	30,000	None	None	15,000(c)
Latcher	279,000	120,000	....	....	250,000(c)
Lincoln	40,000	30,000	None	None	80,000
Morgan	....	120,000(h)	....	....	90,000
Nicholas	40,000	....	None	3,600	40,000
Owen	50,000	40,000	....	10,000	700,000
Rockcastle	17,000	50,000	25,000	None	170,000

State and County	Amount spent in County in 1923 from— County approps.	State approps.	Federal approps.	Other approps.	Total amount available during 1924
Minnesota (Continued)					
Roseau	18,139	23,170	None	None	30,000(l)
Sherburne	20,000	30,000	....	....	50,000
Sibley	182,967	79,326	....	....	287,000
Steele	112,253	....	....	13,000	80,000
Todd	95,000	20,000	....	2,000	120,000
Waseca	210,000	....	....	....	120,000
Washington	68,985	....	....	....	25,000
Watonwan	166,000	20,200	....	....	95,200
Wilkin	101,534	20,000	....	81,534	105,000
Wright	82,733	17,582	....	....	....
Mississippi:					
Madison	240,000	....	25,000	....	225,000
Missouri:					
Audrain	80,000	50,000	....	....	100,000
Buchanan	456,900	None	None	None	300,000
Callaway	18,000	60,000	50,000	20,000(m)	45,000(c)
Clark	45,000	80,000	20,000	35,000	80,000
Clinton	50,000	....	....	None	50,000(l)
Cooper	60,000	....	....	....	55,000(l)
Holt	60,000	75,000	None	None	60,000
Marion	50,000	40,000	20,000	5,000	60,000(c)
Mississippi	176,000	20,000	145,000	....	380,000
Pettis	73,981	14,370	14,370	28,750	70,000
Randolph	....	20,000	....	....	105,000
St. Clair	30,000	60,000	12,000	15,000	95,000
Saline	46,000(n)	....	....	....	....
Wayne	16,000	5,000	....	....	15,000
Montana:					
Chouteau	14,000	....	....	....	30,000
Dawson	88,826	....	....	....	None
Fallon	50,000	2,500	None	None	25,000
Fergus	135,201	3,200	None	None	160,000(l)
Golden Valley	9,585	None	None	4,040	8,000
Judith Basin	30,300	....	....	....	24,000
Missoula	72,063	24,110	1,768	None	105.004
Prairie	35,000	None	None	None	20,000
Roosevelt	18,000	....	48,000	....	....
Sheridan	45,571	None	None	None	40,000
Nebraska:					
Butler	50,000	....	....	....	100,000
Gosper	41,959	266	....	....	30,000
Knox	40,000	None	None	None	60.000
Lancaster	300,000	50.000	50,000	None	600,000
Morrill	99,000	16,500	16,500	66,000	105,000
Nance	8,000	None	None	18,000(k)	20,000
Pierce	6,000	None	None	None	30,000
Polk	26,076	None	None	19,095	50,000
Richardson	140,000	None	None	None	175,000
Sarpy	None	None	None	None	200,000
Sherman	8,000	15,000	3,000	5,000	15,000
Valley	20,000	....	....	....	50,000
Nevada:					
Esmeralda	3,000	None	None	None	3,000(c)
New York:					
Broome	76,000	43,110	....	100,000	195,000
Cayuga	206,338	174,342(h)	....	154,475(d)	535,000
Chautauqua	....	....	....	....	800,000
Jefferson	400,000	100,000	50,000	....	600,000
Livingston	....	....	....	....	8,000
Madison	135,000	42,660	....	18,000(k)	200,000
Niagara	740,000	100,000	4,000	....	500,000

Shelby	75,000	45,000	....	....	150,000
Woodford	55,000	17,000	None	....	65,000
Louisiana:					
Caddo	....	50,000	170,000	700,000 (Parish)	850,000
Evangeline	36,400	None	None	None	800,000
Maine:					
Penobscot	....	51,954	None	42,650	Approx. as 1923
Michigan:					
Aiger	6,000	40,000	....	....	150,000
Alpena	64,000	15,000	None	None	200,000
Branch	131,812	35,000	....	....	185,000
Cass	180,000	132,000	....	....	300,000
Dickinson	96,787	No record	None	....	122,566
Chippewa	100,000	75,000	....	....	325,000
Genesee	321,100	375,000	....	....	645,330(c)
Gladwin	5,000	40,000	None	None	100,000
Houghton	63,000	32,000	....	27,400	200,000
Ionia	178,807	131,486	8,000	218,866	100,000
Kalamazoo	100,000	75,000	50,000	350,000	650,000
Kent	....	....	....	....	1,000,000
Keweenaw	33,583	31,878	....	....	70,000
Lapeer	589,588	60,000	20,000	81,000(d)	750,000
Luce	71,393	24,000	....	47,393	132,750
Macomb	300,000	310,000(h)	....	....	1,000,000
Ottawa	105,000	315,000	....	....	450,000
St Joseph	46,361	38,586	....	37,612	91,358
Van Buren	....	....	....	....	96,000(c)
Wexford	54,000	45,569	....	4,985	110,000
Minnesota:					
Aitkin	86,000	5,000	None	6,000	....
Benton	35,000	20,170	....	6,000	55,000
Blue Earth	129,000	29,000	....	....	160,000
Brown	122,377	12,343	....	....	105,478
Carlton	119,000	175,000	175,000	....	115,000
Carver	101,000	41,000	8,800	....	120,000
Chippewa	75,420	....	....	72,687	50,000
Chisago	85,323	19,694	None	None	60,000
Clay	101,259	20,000	....	....	90,000
Clearwater	31,991	20,000	....	....	35,000
Cook	23,344	19,023	10,000	2,700	85,000
Cottonwood	55,000	20,000	....	20,000	75,000
Dakota	236,004	59,334	....	980	24,874
Dodge	141,200	17,750	None	None	160,000
Faribault	186,000	20,000	None	None	150,000
Freeborn	253,632	78,692	....	....	75,000
Goodhue	224,826	24,100	....	....	224,000
Grant	50,000	20,000	....	....	50,000
Hennepin	2,800,000	66,000	....	....	1,875,000
Houston	151,000	20,000	No date	61,000	131,478
Hubbard	27,000	13,000	....	....	20,000
Isanti	67,000	30,000	None	....	75,000
Jackson	165,000	25,000	....	....	250,000
Kandiyohi	110,000	20,000	None	None	80,000
Koochiching	55,030	5,600	None	None	50,000
Lac qui Parle	105,028	20,170	None	None	48,000
Lake of the Woods	13,844	11,242	None	....	44,000
Lincoln	213,849	18,133	....	....	54,000
Lyon	109,004	37,759	54,104	87,158	145,000
McLeod	101,882	19,424(g)	6,868	....	202,508
Mahnomen	29,106	16,000	....	....	20,000
Marshall	160,311	20,000	....	None	65,000
Martin	150,000	20,000	None	....	130,000
Meeker	100,000	90,000	....	50,000	220,000
Mower	196,000	24,000	....	None	124,000
Murray	70,345	29,133	None	....	100,0001
Otter Tail	190,000	90,000	....	....	650,000
Pine	103,000	20,000	....	....	80,000
Redwood	150,000	23,000	....	30,000	150,000
Rice	899,815	....	....	....	150,000
Rock	61,515	33,348	....	....	80,000
Oneida	200,000	100,000	....	95,000	13,000(d)
Orleans	200,000	....	....	....	120,000(c)
Schuyler	60,045	....	....	....	47,720
Suffolk	58,590	137,407	....	942,427	1,565,251
Sullivan	....	....	....	....	500,000
Tompkins	32,730	....	....	32,730	1,000,000
Yates	30,000	35,000	35,000	....	410,000
North Carolina:					
Ashe	75,000	100,000	....	....	Not much
Burke	50,000	....	....	....	25,000
Columbus	150,000	....	....	....	....
Onslow	....	....	....	....	300,000
Person	25,000	350,000	None	None	....
Sampson	85,000	120,000	None	....	....
Wilson	80,000	....	230,000(h)	None	400,000
North Dakota:					
Barnes	48,700	....	33,700	....	85,000
Hettinger	25,000	....	25,000	....	....
McLean	28,477	5,000	8,123	1,838	35,000
Nelson	15,227	....	12,871	....	95,637
Pierce	10,000	....	8,000	....	6,000
Traill	40,000	1,500	3,000	....	65,000
Ohio:					
Ashtabula	640,000	25,000	210,000	....	1,000,000
Carroll	369,094	316,821(h)	....	....	182,240
Clinton	175,000	97,000	60,000	40,000	286,900
Crawford	188,515	100,000	None	None	312,000
Defiance	375,000	28,000	....	....	300,000
Erie	280,000	55,535	....	....	200,000(1)
Fulton	125,000	115,000	55,000	....	530,000
Holmes	228,050	75,950	None	None	280,000
Madison	60,000	100,000	40,000	10,000	139,000
Medina	....	....	....	....	80,000
Paulding	8,595	....	....	....	180,000
Pickaway	96,488	....	....	....	96,824
Preble	163,000	43,000	120,000	....	138,000
Putnam	25,612	57,300	....	48,156	154,000
Sandusky	200,000	50,000	35,000	50,000	350,000
Shelby	300,000	120,000	None	120,000	....
Stark	830,000	5,000	65,000	200,000	1,100,000
Warren	....	....	....	....	330,000
Wyandot	40,000	....	....	....	182,000
Oklahoma:					
Atoka	48,114	8,000	....	....	70,174
Blaine	38,000	29,000	....	....	315,500
Caddo	45,886	....	....	40,000	186,800
Coal	33,030	6,000	....	....	32,882
Craig	45,000	None	None	None	....
Creek	375,000	None	50,000	None	800,000
Harmon	19,114	8,620	None	8,904	45,435
Jackson	70,000	....	....	....	75,000
Kingfisher	100,000	None	None	50,000	150,000
Latimer	45,000	None	15,000	None	....
Okfuskee	40,000	None	160,522	160,522	367,330
Tillman	96,473	39,786(k)	None	56,687	89,253
Oregon:					
Clatsop	400,000	75,000	....	....	471,250
Douglas	1,000,000	500,000	17,000	....	300,000
Marion	450,000	20,000	....	....	350,000
Morrow	....	51,000	None	None	60,000
Sherman	112,704	15,814	....	....	65,000
Wallowa	126,628	118,000	10,000	....	191,000
Yamhill	72,000	36,000	....	55,000	140,000
Pennsylvania:					
Cambria	1,478,657	None	None	97,274	....
Erie	719,176	None	None	....	1,200,000
Indiana	467,512	None	None	....	1,000,000
Jefferson	300,000	125,000	....	....	700,000
Lackawanna	400,000	None	None	....	340,000
Northampton	....	....	....	....	1,000,000
Warren	100,000	50,000	None	None	1,000,000

HIGHWAY FUNDS (Continued)

State and County	Amount spent in County in 1923 from— County approps.	State approps.	Federal approps.	Other approps.	Total amount available during 1924
South Carolina:					
Cherokee	75,390	24,790	32,465	....	133,000
Greenwood	25,000	35,000	None	None	200,000
Marlboro	45,000	....	15,000	20,000	400,000
Newberry	118,000	None	28,000	None	150,000
Orangeburg	150,000	None	24,000	None	175,000
Pickens	75,000	....	22,000	....	210,000
Union	49,000	....	13,000	....	70,000
South Dakota:					
Buffalo	28,314	....	....	....	40,000
Douglas	22,345	....	....	....	45,000(c)
Faulk	35,065	....	....	....	200,000
Jackson	24,500	14,675(h)	....	None	15,000
McCook	50,048	77,000(h)	....	....	67,000
Moody	40,000	....	....	....	37,000(c)
Pennington	113,896	78,000	78,000	None	200,000
Potter	46,958	....	....	....	48,991
Roberts	30,000	....	....	None	38,000(c)
Yankton	134,259	86,000(h)	....	None	123,000
Tennessee:					
Chester	1,000	None	None	....	15,000
Cocke	150,000	100,000	50,000	....	200,000
Cumberland	20,000	....	....	....	....
Grundy	105,000	15,000	None	None	220,000
Hawkins	100,000	100,000	100,000	....	150,000
Jackson	8,000	....	....	....	....
Johnson	8,000	15,000	....	....	15,000
Knox	380,000	200,000	....	180 000	400,000
Rutherford	18,000	....	....	....	750,000
White	....	....	200,000	....	400,000
Texas:					
Anderson	15,000	....	1,000	....	2,000,000
Angelina	400,000	....	300,000	....	500,000
Aransas	....	50,000	None	15,000	....
Brewster	20,000	....	30,000	....	420,000
Cameron	500,000	300,000(h)	....	....	200,000
Carson	15,000	....	....	....	25,000
Coleman	503,316	117,862(h)	....	....	500,000
Collin	900,000	150,000	80,000	....	800,000
Colorado	35,000	15,000	....	....	25,000
El Paso	215,670	None	None	None	1,850,000
Floyd	5,000	None	None	5,000(k)	36,000
Galveston	114,761	....	....	....	140,000
Gonzales	80,000	15,000	25,000	....	345,000
Guadalupe	68,000	74,000	27,000	....	200,000
Hunt	60,450	82,950	32,850	....	737,000
Jim Wells	30,000	....	....	....	1,400,000
Johnson	35,960	107,890	143,850	....	150,000
Orange	500,000	None	None	None	350,000
Parmer	10,000	5,500	None	None	....
Potter	None	None	None	28,000	180,000
San Patricio	200,000	50,000	55,000	95,000	147,000
Smith	140,000	100,000	100,000	....	500,000
Somerville	57,500	27,500	....	....	133,000
Titus	100,000	25,000	25,000	....	....
Uvalde	80,000	13,000	42,500	....	400,000
Ward	100,000	50,000	50,000	None	....
Wilson	....	None	None	Small amount	945,000
Vermont:					
Orange	....	60,000	130,000	....	225,000
Virginia:					
Halifax	25,000	60,000	27,000	....	95,000
Pittsylvania	65,000	35,000	....	....	150,000
Tazewell	190,000	20,000	....	....	100,000
Washington:					
Adams	30,000	....	....	....	280,000
Benton	....	42,600	None	80,000	27,800
Clallam	....	....	....	....	350,000
Ferry	38,000	....	....	....	220,000
Franklin	87,000	14,000	None	None	....
Island	35,850	....	....	....	40,000
Jefferson	85,000	80,000	....	....	278,000
Lincoln	154,000	163,000	....	3,000	299,000
Pend Oreille	82,403	25,000	25,000	....	131,000
Snohomish	....	....	....	95,000	....
Spokane	1,116,675	415,000	....	....	1,315,700
Wahkiakum	29,677	3,500	....	2,500(m)	32,000
Whatcom	....	70,000	....	....	125,000
Whitman	340,000	75,000	75,000	....	640,000
West Virginia:					
Boone	84,000	180,000	....	50,000	....
Cabell	300,000	....	....	....	300,000
Greenbrier	50,000	500,000	....	....	50,000
Marshall	225,000	....	....	....	225,000
Mineral	70,000	150,000	20,000	....	200,000
Monongalia	....	172,000	112,000	....	75,000
Monroe	25,000	130,000	....	....	150,000
Morgan	35,000	75,000	11,000	81,000	250,000
Pocahontas	70,000	240,000	....	....	420,000
Upshur	50,000	175,000	....	....	625,000
Wisconsin:					
Adams	8,454	6,786	30,000	....	15,000
Bayfield	163,150	62,319	....	....	283,074
Calumet	21,087	7,003	....	33,859	177,361
Dane	....	....	....	....	730,967
Door	3,600	5,000	None	....	90,000
Grant	95,000	66,156	50,000	91,000	236,000
Jefferson	....	....	....	....	350,000
Juneau	10,768	21,536	220,000	....	84,270
La Crosse	....	10,000	23,000	327,541	280,059
Langlade	43,600	4,691	....	....	87,694
Marinette	142,223	6,006	....	57,904	108,000
Milwaukee	230,000	157,000	200,000	....	400,000
Oconto	69,700	53,000	20,000	....	150,000
Richland	133,159	54,635	84,000	....	208,563
Shawano	77,484	8,000	....	....	200,966
Trempealeau	137,545	52,177	125,000	25,000	300,000
Vernon	294,052	8,278	....	....	163,000
Waukesha	711,500	14,300	190,000	40,000	....
Wyoming:					
Big Horn	30,000	....	....	None	None
Campbell	32,976	....	....	....	25,000
Crook	18,250	25,000	25,000	12,500	90,000
Sheridan	64,300	50,000	15,000	....	60,000

(a)—Includes both state and county appropriations. (b)—County aid only; in addition, state will grade 35 mi. and concrete 10 mi. (c)—County alone. (d)—By townships. (e)—37 mi. of 18 ft. concrete road. (f)—State construction. (g)—For maintenance. (h)—Includes both State and Federal. (i)—Includes State, Federal and County bonds. (k)—Motor vehicle licenses. (l)—Approximate; amount not known yet. (m)—Donations. (n)—County bridges only.

GRADING AND SURFACING DURING 1923

MILES OR SQUARE YARDS UNLESS OTHERWISE STATED

State and County	Grading Amount	Grading Cost	Earth Surface Amount	Earth Surface Cost
Alabama:				
Lee	14	....	....	....
Montgomery	20	$40,000	....	....
Pike	15	....	15	....
Arkansas:				
Hempstead	3	3,600	....	....
California:				
Mono	32.5	8,000c	....	....
San Joaquin	9.66	13,473c	....	....
San Luis Obispo	5	15,000	....	....
Colorado:				
Lake Cheyenne	1	3,000	....	....
Mesa	29	37,778	2	3,180
Rio Blanco	21	5,000d	1.45	14,566d
Florida:				
Flagler	10,000	....	....	....
Santa Rosa	10	48,400a	8	....
Georgia:				
Bibb	80,000cu.yd	25,000d	....	....
Walker	11	95,000d	....	....
Idaho:				
Boise	7	....	7	....
Clearwater	25	37,500	....	....
Idaho	12	250,000	....	....
Nez Perce	1	26,000	0.5	20,000
Power	30	15,000	....	....
Twin Falls	10	7,510d	....	....
Illinois:				
Adams	80	5,000	....	....
Bond	0.4	4,500	30	1,000
Brown	....	....	....	14,000
Carroll	7.5	76,000d	....	....
Cumberland	10	24,500	....	5,000
Douglas	....	....	....	19,000d
Fayette	200	20,000	....	....
Fulton	80	35,000d	200	10,000
Jasper	....	....	....	15,000
McDonough	170	....	195	....
Macoupin	....	....	....	25,000d
Marion	100	7,500c	....	....
Monroe	....	20,000c	....	....
Peoria	180a	92,000	....	....
Pulaski	40	8,000d	....	....
Putnam	8	560	....	....
Schuyler	6	120,000	....	75,000
Stephenson	50	5,000d	....	....
Washington	....	....	95	36,162d
White	14	130,000	600	18,000
Woodford	95,000cu.yd	21,850	844,800	10,386
Indiana:				
Jackson	25,000	10,000d	10,000	2,510d
Newton	....	10,000	....	....
Spencer	8	50,000c	....	....
Iowa:				
Adair	133,000	44,000	60,000	20,061
Adams	3	....	....	....
Black Hawk	31	82,700	....	....
Boone	65,000	30,000	....	....
Bremer	3.5	16,500	....	....
Cedar	43	6,533c	....	....
Cerro Gordo	20	59,000	....	....
Chickasaw	18	54,000	....	....
Clarke	8	....	....	100,000d
Clayton	20	150,000	....	....
Crawford	....	25,000	....	....
Decatur	....	....	5.25mi.	60,000(g)
Dickinson	....	....	20	30,000(g)
Dubuque	18 mi.	200,000(d)	....	....
Emmet	5 mi.	....	....	....
Fayette	35 mi.	10,800	....	....
Floyd	20 mi.	55,000(d)	....	....
Greene	175,000	105,000	....	....
Grundy	12 mi.	85,000(d)	....	....
Guthrie	7.0 mi.	33,000	....	....
Hamilton	50,000 yd.	13,000	....	....
Hancock	11 mi.	60,000(d)	....	....
Jones	10 mi.	75,000	....	....
Kossuth	80,000cu.yd	24,000(d)	....	....
Lee	23 mi.	158,000(d)	....	....
Linn	110,000cu.yd	44,000	....	....
Lyon	14 mi.	68,000	....	....
Madison	2 mi.	18,826	154 mi.	45,723
Marion	13 mi.	80,000(d)	....	....
Monona	386,591	....	81,140	....
Monroe	9½ mi.	70,000(d)	....	....
O'Brien	4,555 yd	1,777	....	....
Osceola	11 mi.	26,000	....	....
Palo Alto	38,269	11,027	....	....
Pocahontas	7.5 mi.	9,882	....	....
Poweshiek	8 mi.	....	....	....
Ringgold	9 mi.	90,000	....	....
Sac	5 mi.	10,000	....	....
Scott	6.47 mi.	19,648	....	....
Tama	25 mi.	190,000(d)	....	....
Union	3 mi.	20,000(d)	....	....
Van Buren	16 mi.	80,000	....	....
Webster	36,000	10,800	....	....
Kansas:				
Barber	50 mi.	5,000	2 mi.	3,000
Barton	25	2,250	....	....
Bourbon	20	....	....	....
Brown	....	....	13,557	....
Butler	240	25,000(d)	....	....
Cheyenne	....	41,000(d)	....	8,000(g)
Clay	10	4,000	5	4,000(g)
Cowley	35	4,000	....	....
Doniphan	99.75	3,000(d)	....	....
Douglas	163	31,207	....	....
Ellis	60	3,000(d)	....	....
Finney	15	10,000(d)	12	20,000(g)
Ford	30	....	....	....
Geary	35.4	....	....	....
Gray	101	27,834	....	....
Harvey	45	3,250	....	....
Jackson	....	....	8.74	51,037(d)
Kingman	2	5,400	....	....
Marion	130	6,500	....	....
Montgomery	14	70,000(d)	....	....
Pawnee	18	37,926(d)	....	....
Republic	85	16,000	....	....
Rooks	175	9,760	....	....
Sheridan	....	....	100	10,000
Sumner	267	50,165(d)	....	....
Thomas	30	750(d)	....	....
Wabaunsee	50	10,000	....	....
Wilson	125(a&d)	123,475	....	....
Kentucky:				
Allen	8	6,000	....	....
Crittenden	16	100,000(d)	....	....
Daviess	3½	10,000	625	100,000
Fayette	1¾	2,000	5	1,000
Fleming	300	4,000	....	....
Kenton	15,000cu.yd	10,500(d)	....	....
Leslie	....	....	1.7	57,000(c)
Morgan	....	120,000(c)	....	....
Nicholas	3	....	....	....
Rockcastle	2	12,000(d)	....	....
Woodford	7	2,100	....	....
Louisiana:				
Evangeline	132	36,400(d)	....	....
Maine:				
Penobscot	....	6,000	....	....
Michigan:				
Alpena	55,000cu.yd	34,000	....	....
Cass	13	52,000	....	....
Chippewa	8	70,000(d)	....	....
Dickinson	15.8	141,507(d)	....	....
Ionia	3.3	30,000(d)	....	....
Keweenaw	2	6,229	....	....
Ottawa	10	60,000(d)	....	....
St. Joseph	11	46,361(h)	....	....
Van Buren	2.6	....	....	....
Wexford	1.13	6,270	....	....
Minnesota:				
Aitkin	46	74,000(d)	....	....
Benton	10.1	21,446(d)	2.1	4,754(d)
Blue Earth	27	....	....	....
Brown	9	8,850	....	....
Carlton	42.25	57,241	....	....
Carver	14	101,000(d)	....	....
Chippewa	9	30,000	....	....
Clay	50	60,110(d)	....	....
Clearwater	5	38,591(d)	....	....
Cook	27	130,644(d)	....	....
Cottonwood	147,431cu.yd	37,169	....	....
Dakota	26	208,692	....	....
Dodge	14½	52,271	....	....
Faribault	6.1	16,760	....	....
Freeborn	15	114,000(d)	35	56,139(d)
Goodhue	....	92,343(d)	....	....
Grant	17	50,000(d)	....	....
Hennepin	60	....	50	....
Hubbard	5	11,000(h)	50	....
Isanti	15	45,706	....	....
Jackson	21	55,000	....	....
Kandiyohi	1	5,000	....	....
Koochiching	7	1,000	....	....
Lac Qui Parle	12.49	32,629(c)	....	....
L. of the Woods	10	23,286	....	....
Lincoln	56	233,533(d)	....	....
Lyon	36.01	143,665(d)	....	....
McLeod	11.09	38,922(d)	....	....
Mahnomen	108,637cu.yd	35,106	....	....
Marshall	30	53,500(c)	2	1,400(c)
Martin	17.6	83,088(d)	....	....
Meeker	42	175,000(d)	....	....
Murray	16	20,000(d)	....	....
Otter Tail	....	80,000(d)	....	....
Pine	20	20,000	1	700
Redwood	32	78,000(c)	....	....
Rice	963,322	361,582	....	....
Rock	17.1	24,518(d)	....	....
Roseau	12.8	18,045	....	....
Sherburne	9	16,500(c)	....	....
Sibley	267,113	....	2,687	6,872
Steele	25	71,137(d)	....	....
Todd	18	35,000(d)	....	....
Waseca	40	....	....	...
Washington	3.5	16,845	....	....
Watonwan	14	42,876	31	49,680
Wilkin	23.3	59,576(d)	....	....
Wright	18.7	55,838	....	....

GRADING AND SURFACING IN 1923 (Cont'd)

State and County	Grading Amount	Grading Cost	Earth Surface Amount	Earth Surface Cost
Mississippi:				
Madison	120,000	3000	....	....
Missouri:				
Buchanan	10	187,000(d)	....	....
Clark	....	....	4	55,000(h)
Clinton	5½	....	....	....
Holt	12	6,250(d)	....	....
Marion	200	3,100(d)	....	....
Mississippi	60,000	24,000	....	....
Pettis	10	1,000	....	....
Randolph	6	20,000	....	....
Wayne	10	3,000	....	....
Montana:				
Chouteau	10	....	....	....
Dawson	27.5	....	....	....
Fallon	20	3,000(d)	....	....
Fergus	7½	11,841	....	....
Judith Basin	9	550	....	....
Missoula	3.28	32,811	2.1	1,641
Prairie	24	6,000(c)	....	....
Roosevelt	....	....	11	27,000(h)
Sheridan	50	7,500(c)	30	600
Nebraska:				
Butler	15,000	....	....	....
Gosper	61	4,575	....	....
Knox	30	2,000(d)	....	....
Lancaster	200	200,000	....	....
Morrill	20	1,000	3	6,100
Otoe	260	8,580	....	....
Pierre	approx 85	....	....	....
Polk	78	7,626	....	....
Richardson	....	30,000	....	10,000
Sherman	....	10,000(d)	....	40,000(h)
Valley	10,000	20,000	....	....
New York:				
Cayuga	....	....	500	....
Jefferson	....	100,000(c)	....	....
Oneida	48	1,440	....	....
Yates	3	100,000(c)	....	....
North Carolina:				
Burke	40	40,000(d)	....	....
Madison	3	....	....	....
Person	12	6,000	....	....
Sampson	40	....	40	....
Wilson	30	30,000	10	5,000
North Dakota:				
Barnes	35	55,450(d)	....	....
Hettinger	11	30,000(d)	....	....
McLean	5	15,824	....	....
Nelson	4	12,175	....	....
Pierce	15(a)	6,000(h)	....	....
Traill	6	9,000	50	10,000
Ohio:				
Carroll	176,517.7cu.yd	98,745(d)	....	....
Holmes	5.9	42,000(d)	....	....
Medina	10	1,200	....	....
Oklahoma:				
Atoka	21	13,000	60	10,000
Blaine	76	1,520	110	880
Caddo	15	....	8	....
Coal	6	3,000	....	....
Craig	6	300	....	8,000
Creek	20	4,000(d)	....	....
Harmon	....	3,000(d)	....	....
Jackson	60	2,100	....	....
Kingfisher	100	3,500	3	6,000(g)
Latimer	5	1,500(d)	20	8,000(h)
Tillman	243	8,000(d)	....	....
Oregon:				
Clatsop	5	....	....	....
Douglas	108.8	....	....	....
Morrow	8	....	9	....
Sherman	16	....	3	....
Wallowa	15	5,000(d)	....	....
Yamhill	14	25,000(d)	100	....
Pennsylvania:				
Carbon	3	....	....	....
South Carolina:				
Cherokee	55	....	47	....
Newberry	47	140,000	47	....
Orangeburg	35	....	35	....
Pickens	....	110,000(d)	....	15,000(h)
South Dakota:				
Buffalo	18	10,000(c)	....	....
Douglas	55	7,616(c)	....	....
Faulk	....	....	46	....
Jackson	....	....	5.59	3,500
McCook	28	107,548(d)	....	....
Moody	38	....	....	....
Pennington	42	64,000(d)	....	....
Potter	30	23,586	....	....
Roberts	53	....	....	....
Yankton	26.5	80,000	....	....
Tennessee:				
Cocke	18	15,000(d)	....	....
Grundy	17	72,000(c)	....	....
Knox	3	18,000(d)	....	....
Texas:				
Anderson	5	5,000	....	....
Aransas	10	2,000	....	....
Brewster	25	15,000	....	....
Cameron	200	50,000(d)	....	....
Texas (Continued)				
Colorado	100	20,000(d)	....	....
El Paso	260,000cu.yd	58,000(d)	....	....
Gonzales	15	48,000	....	....
Jim Wells	50	40,000	....	....
Johnson	25	36,700	....	....
Smith	40	80,000(d)	10	20,000(d)
Somervell	35	30,000(d)	....	....
Titus	125,000 yd.	20,000	....	....
Uvalde	72	64,000	....	....
Ward	44,450	6,667	....	....
Vermont:				
Orange	..	....	20	....
Virginia:				
Pittsylvania	7	16,000(d)	....	....
Tazewell	15	60,000(d)	....	....
Washington:				
Clallam	10	50,000	....	....
Ferry	5	1,000	....	....
Island	4	1,300(d)	....	....
Lincoln	10	24,000(d)	....	....
Pend Oreille	6	6,000	....	....
Snohomish	approx.10	approx.20,000	....	....
Wahkiakum	..	....	40	18,000(c)
Whatcom	23,890cu.yd.	12,423	....	....
West Virginia:				
Boone	15	314,000(d)	....	....
Cabell	..	10,000(d)	....	....
Greenbrier	3½	10,000	....	....
Mineral	8	80,000(d)	....	....
Monroe	10	100,000(h)	....	....
Morgan	12	127,000(d)	15	30,000(h)
Pocahontas	20	200,000(d)	....	....
Upshur	7	70,000	....	....
Wisconsin:				
Adams	9	8,440	3	6,500
Bayfield	44	15,840(d)	....	....
Dane	..	250,000(d)	....	....
Door	24	360	....	....
Florence	13	....	....	....
Grant	10.3	26,353(d)	....	....
Jefferson	60	140,000(d)	....	....
La Crosse	39	16,082(d)	1	501(h)
Langlade	12	18,308(d)	....	....
Marinette	63	....	....	....
Oconto	8	5,500	....	....
Richland	5.5	83,891(c)	....	....
Trempealeau	..	85,000(d)	....	184,721(h)
Vernon	22	156,817(d)	2.7	13,200(h)
Wyoming:				
Big Horn	40	10,000(d)	....	....
Campbell	25,000cu.yd.	5,000	90	4,500
Crook	7	35,000	....	....
Sheridan	15	31,000(d)	....	....

a—Includes surfacing. b—Includes bridges. c—Includes culverts. d—Includes bridges and culverts. g—Includes grading. h—Includes surfacing, bridges and culverts.

GRAVEL AND PLAIN MACADAM LAID DURING 1923

Miles or square yards unless otherwise stated. Cost does not include grading, bridges or culverts unless indicated by foot note.

State and County	Gravel Amount	Gravel Cost	Plain Macadam Amount	Plain Macadam Cost
Alabama:				
Lee	14	$85,000g	....	....
Montgomery	25	125,000	....	....
Arizona:				
Maricopa	97	388,000d	....	....
Arkansas:				
Hempstead	1	4,000	....	....
California:				
Fresno	19e	90,000	....	....
Mono	8	8,000c	....	....
San Joaquin	....	....	20	$95,000c
Colorado:				
Lake	2	1,500	....	....
Mesa	6.4	7,045	....	....
Rio Blanco	2	14,000d	....	....
Florida:				
Broward	....	....	120,000	120,000g
Flagler	....	....	200,000	....
Georgia:				
Walker	14	20,000d	....	....
Idaho:				
Boise	1.75	....	....	....
Clearwater	10	20,000	....	....
Idaho	11	50,000	....	....
Power	20	24,740	....	....
Twin Falls	12	52,000c	....	....

GRAVEL AND PLAIN MACADAM LAID DURING 1923 (Continued)

State and County	Gravel Amount	Gravel Cost	Plain Macadam Amount	Plain Macadam Cost
Illinois:				
Adams	20	30,000	....	....
Cumberland	....	19,500	....	....
Douglas	....	3,000	....	....
Kane	....	50,000	....	....
Monroe	....	....	....	5,000
Pulaski	5	25,000d	....	....
Putnam	4	7,000	....	....
Stephenson	2	6,000d	2	5,000d
White	10	35,250	....	....
Indiana:				
Dubois	9.5	107,700d	22.4	260,800d
Howard	....	....	2	8,500c
Jackson	25,000	30,000c	1,000	1,500c
Jennings	2.03	8,613c	7.88	49,137c
Newton	....	....	....	99,000
Putnam	5.5	42,000c	11.5	60,000c
Spencer	24	163,000c	....	....
Vigo	12,320cu.yd	35,000d	....	....
Warrick	....	....	12	200,000c
Iowa:				
Bremer	4.5	4,600	....	....
Buena Vista	6	12,000d	....	....
Cerro Gordo	7	14,700	....	....
Chicasaw	12	18,000	....	....
Clayton	20	50,000	....	....
Crawford	6.5	16,000	....	....
Emmet	23	....	....	....
Fayette	29.5	31,000	....	....
Floyd	6	74,000f	....	....
Hamilton	15,000	15,000	....	....
Hancock	5	5,000c	....	....
Howard	10.5	13,000	....	....
Jones	1	4,000	....	....
Kossuth	100,000	40,000d	....	....
Linn	21	84,000	....	....
Lyon	11	17,000	....	....
Osceola	11	30,000	....	....
Palo Alta	3,200	1,668	....	....
Pocahontas	44	38,000	....	....
Sac	22	72,000	....	....
Scott	7.47	46,662g	....	....
Tama	26	110,000d	....	....
Warren	2.25	6,112	....	....
Webster	10.5	23,000	....	....
Kansas:				
Barber	0.3	1,000	....	....
Butler	6	72,000f	....	....
Clay	0.12	500g	....	....
Crawford	6	60,000f	....	....
Finney	3	10,000f	....	....
Harvey	23	18,500	....	....
Montgomery	4	37,000f	....	....
Pawnee	37	147,409f	....	....
Wabaunsee	1	1,400	....	....
Wilson	9	117,000f	....	....
Kentucky:				
Allen	10	13,000	....	....
Boyle	....	....	7	30,000f
Carroll	13h	5,000	2.25h	4,000d
Clark	....	....	8	24,000
Daviess	2.5	9,000	....	....
Fayette	....	....	23	90,000
Nicholas	....	....	9	....
Rockcastle	7	15,000	3	44,000
Shelby	....	....	....	70,000
Woodford	....	....	8	24,800
Maine:				
Penobscot	....	45,954	....	....
Michigan:				
Alger	....	....	4	40,000
Alpena	63,000	31,000	....	....
Branch	27	107,418f	....	....
Cass	....	....	7	140,000
Chippewa	2	15,000f	7	85,000f
Dickinson	2.2	5,249f	....	....
Genessee	14	100,000f	....	....
Ionia	32	250,760f	....	....
Kalamazoo	30	168,000f	7	74,000f
Kent	25.87	237,470f	....	....
Keweenaw	51	5,317	....	....
Lapeer	42	315,000f	....	....
Luce	2.5	13,750d	....	....
Van Buren	1.3	....	....	....
Minnesota:				
Benton	10.5	15,868d	....	....
Blue Earth	25.5	....	....	....
Brown	33	20,855	....	....
Carlton	19	19,374	....	....
Carver	13	19,000d	....	....
Chippewa	15	15,000	....	....
Chicago	28	72,939f	....	....
Clay	30	27,000d	....	....
Clearwater	3	3,400f	....	....

State and County	Gravel Amount	Gravel Cost	Plain Macadam Amount	Plain Macadam Cost
Minnesota (Continued)				
Cook	2	2,500d	....	....
Cottonwood	18.5	23,071	....	....
Dakota	11	21,659	....	....
Dodge	23.5	53,415	....	....
Faribault	74.5	134,000	....	....
Goodhue	....	118,743d	....	....
Hennepin	50	....	10	....
Isanti	5	11,383	....	....
Jackson	33	50,000	....	....
Kandiyohi	87	95,000	....	....
Koochiching	9	7,967	....	....
Lac Qui Parle	31.68	29,255c	....	....
L. of the Woods	....	1,800	....	....
Lincoln	23	27,976c	....	....
Lyon	12.01	16,423	....	....
McLeod	17.25	31,545f	....	....
Marshall	45,000cu.yd	72,000c	....	....
Martin	33.16	45,289c	....	....
Meeker	14	18,000d	....	....
Mower	78k	980	....	....
Murray	27.75	33,000c	....	....
Otter Tail	....	20,000	....	....
Redwood	20	17,000c	....	....
Rice	47,487	62,860	....	....
Rock	26.5	38,343d	....	....
Roseau	8.8	11,981	....	....
Sherburne	12	11,000c	....	....
Sibley	43,672	69,082f	....	....
Steele	27	25,600	....	....
Todd	11	15,000d	....	....
Waseca	16	....	....	....
Washington	3	7,653	....	....
Wright	26.7	31,791	....	....
Mississippi:				
Madison	82,500	221,500	....	....
Missouri:				
Audrain	3	50,000f	....	....
Buchanan	....	....	3.25	10,000f
Callaway	6	18,000	....	....
Clark	1	8,000f	....	....
Marion	10	18,000f	....	....
Mississippi	41,000	45,100	....	....
Pettis	4	4,000	....	....
St. Clair	10	32,000f	....	....
Wayne	20	10,000	....	....
Montana:				
Dawson	15	....	....	....
Fallon	20	30,000c	....	....
Fergus	5	10,310	....	....
Missoula	5.74	18,612	....	....
Prairie	3	3,000c	....	....
Roosevelt	5	36,000f	....	....
Sheridan	3	....	....	....
Nebraska:				
Lancaster	10	50,000g	....	....
Morrill	15	24,000	....	....
New York:				
Broome	....	....	15	180,000f
Cayuga	6	....	....	....
Jefferson	....	10,000c	....	50,000c
Madison	....	....	2	14,000f
Oneida	1.5	600g	0.75	3,750g
Schuyler	2.5	....	....	....
North Carolina:				
Wilson	2	2,000	....	....
North Dakota:				
Barnes	20.5	26,950f	....	....
Nelson	5.25	17,815	....	....
Pierce	12	12,000f	....	....
Ohio:				
Crawford	....	....	10.5	84,000f
Defiance	....	....	13	163,000f
Erie	....	....	115,000	108,000f
Fulton	....	....	3	60,000f
Holmes	8.5	100,000f	....	....
Medina	1	5,000g	....	....
Paulding	4,000	1,800	4,892	6,794
Pickaway	4.43	31,848f	....	....
Sandusky	....	....	2	20,000f
Stark	....	....	3.08	66,384d
Wyandot	....	....	6	42,000f
Oklahoma:				
Atoka	9,000	3,160	....	....
Blaine	3,000	1,341	....	....
Caddo	10.5	....	....	....
Coal	6	7,000	....	....
Craig	2	4,000	....	....
Latimer	23.26	316,098f	....	....
Okfuskee	18.45	321,030f	....	....

GRAVEL AND PLAIN MACADAM LAID DURING 1923 (Continued)

State and Country	Gravel Amount	Gravel Cost	Plain Macadam Amount	Plain Macadam Cost
Oregon:				
Clatsop	....	....	6.5	....
Douglas	122.7	....	....	....
Marion	25	75,000f	....	....
Morrow	12	....	20	....
Sherman	....	....	13	....
Wallowa	15	....	....	....
Yamhill	13,000	....	6	....
Pennsylvania:				
Carbon	....	....	0.5	7,000c
Erie	20	20,919f	....	....
Indiana	....	....	11,000	15,000f
South Carolina:				
Cherokee	1.5	....	....	....
South Dakota:				
Douglas	13	....	....	....
McCook	10	19,520f	....	....
Moody	20	....	....	....
Pennington	2	6,500f	....	....
Roberts	32	....	....	....
Yankton	22	41,000	....	....
Tennessee:				
Cocke	....	....	30	150,000
Cumberland	111	14,000	....	....
Grundy	....	....	5	30,000c
Knox	....	....	20	....
Rutherford	....	....	18,000	....
Texas:				
Angelina	26	260,000f	....	....
Brewster	....	15,000	....	....
Coleman	80	621,178f	....	....
Collin	135	....	....	....
Colorado	8	30,000d	....	....
El Paso	18	104,700f	....	....
Gonzales	12	72,000	....	....
Guadalupe	4	18,000	....	....
Hunt	28	165,750	1	10,500
Johnson	25	198,000	....	....
Orange	30	340,000f	....	....
Potter	5.5	28,000f	....	....
Smith	20	40,000d	....	....
Somerville	6	31,000f	....	....
Titus	15,000	21,105d	....	....
Uvalde	37.5	56,250	....	....
Ward	12.5	41,872	....	....
Virginia:				
Tazewell	....	....	9	60,000c
Washington:				
Clallam	20,000	30,000c	....	....
Ferry	4	1,200	....	....
Franklin	15	62,000f	....	....
Island	2	10,000f	....	....
Jefferson	8	120,000f	....	....
Lincoln	10	25,000c	....	....
Pend Oreille	1.8	17,000g	....	....
Snohomish	10	....	....	....
Spokane	....	....	39.9	....
Whatcom	600 cu.yd.	1,176	....	....
Whitman	....	....	6	20,000
West Virginia:				
Greenbrier	0.5	2,000	....	....
Mineral	....	....	8	160,000f
Monroe	....	....	6	60,000f
Morgan	....	....	3m	45,000f
Pocahontas	5	50,000d	....	....
Wisconsin:				
Adams	12	32,000	....	....
Bayfield	16	14,400c	....	....
Calumet	3.25	10,011g	2.25	3,738g
Dane	....	150,000	....	....
Florence	5.5	....	....	....
Grant	35.2	95,800f	....	....
Langlade	11.8	14,594f	....	....
Marinette	36	128,551n	....	....
Oconto	21	39,200	....	....
Richland	18.1	94,480f	....	....
Shawano	17.5	....	....	....
Trempealeau	84,721	....	....	....
Vernon	0.25	1,278f	....	....
Waukesha	12	25,000f	....	....
Wyoming:				
Crook	9	16,000	....	....

b—Includes bridges. c—Includes culverts. d—Includes bridges and culverts. e—Oil treated. f—Includes bridges, culverts and grading. g—Includes grading. h—Reconstructing. i—Stamp sand. k—Surfacing only. l—Slag. m—With bituminous surface. n—Grading and surfacing part, the rest surfacing only

CONCRETE AND BRICK PAVEMENT LAID IN 1923

State and County	Cement Concrete (Reinforced Indicated by R) Amount	Cement Concrete Cost	Brick Amount	Brick Cost
Arizona:				
Maricopa	86	$2,580,000f	....	....
Arkansas:				
Hempstead	2R	35,000	....	....
Poinsett	10R	272,000	....	....
California:				
San Luis Obispo	1	25,000g	....	....
Sutter	0.52R	14,121g	....	....
Connecticut:				
New Haven	3,000	8,250g	....	....
Georgia:				
Bibb	46,200	90,000f	....	....
Illinois:				
Carroll	7.5	173,000d	....	....
Douglas	57,179R	137,904f	....	....
Fulton	85,000	170,000d	....	....
Hancock	10	210,000f	....	....
Kane	50,800R	150,000f	....	......
Mason	5.2	104,000f	....	....
Peoria	4.5R	135,000g	....	....
Pulaski	18.0	32,000c	....	....
Schuyler	17	415,000f	....	....
Stephenson	20	650,000f	....	....
White	4R	75,000	....	....
Whiteside	4.22R	74,924	....	....
Wile	....	90,000f	....	....
Winnebago	12.2	375,453f	....	....
Indiana:				
Jackson	30,000R	60,000d	....	....
Putnam	....	....	4.5	....
Vigo	21,200	70,000f	15,900	150,000f
Wayne	100,000	264,000f	....	....
Iowa:				
Black Hawk	10R	330,000	....	....
Buchanan	20,000R	80,000g	....	....
Des Moines	1.5R	31,996g	....	....
Greene	31,500R	80,000g	....	....
Kossuth	80,600R	100,000d	....	....
Lucas	1,693R	4,859g	....	....
Scott	23.6R	730,127g	....	....
Kansas:				
Barton	11,000R	25,300	....	....
Bourbon	0.75	....	0.25	....
Butler	....	....	9	360,000f
Crawford	3.5	101,500f	....	....
Doniphan	8.0	328,000f	....	....
Douglas	18.25	975,437g	....	....
Ford	....	....	....	7,303g
Marion	....	....	1.75	65,000f
Reno	1,045R	2,539	27,500	105,875
Sumner	26.8	565,700b	....	....
Kentucky:				
Kenton	6R	202,000f	....	....
Michigan:				
Branch	0.83	24,394f	....	....
Cass	7R	182,000	....	....
Genesee	3,039R	96,100f	....	....
	8.00	360,000f	....	....
Ionia	3.3R	128,394f	....	....
Kalamazoo	6.50	209,000f	....	....
Kent	2,688R	51,200f	....	....
	3,827	66,500f	....	....
Lapeer	3.68	110,000f	....	....
Ottawa	3R	80,000f	....	....
Van Buren	3.0	....	....	....
Wexford	7,740R	8,049	....	....
	5,558	5,391	....	....
Minnesota:				
Carlton	9R	....	....	....
Hennepin	6.5	....	....	....
Washington	63.1cu.ydsR	1,325	....	....
Mississippi:				
Madison	200cu.ydsR	3,200	....	....
Missouri:				
Buchanan	7.25	259,900f	....	....
Marion	1.5R	37,000f	....	....
Mississippi	74,000	207,200	....	....
Nebraska:				
Sherman	....	25,600f	....	....
New York:				
Cayuga	18R	....	....	....
Chautauqua	31	926,000	....	....
Jefferson	165,000	....	....	....
Madison	4	60,000	....	....
Niagara	....	615,000f	....	....
Suffolk	102,430	342,124f	....	....

CONCRETE AND BRICK LAID IN 1923 (Continued)

State and County	Cement Concrete Reinforced Indicated by R Amount	Cement Concrete Cost	Brick Amount	Brick Cost
North Carolina:				
Columbus	16	480,000	....	....
Person	11	300,000	....	....
Sampson	3	97,000	....	....
Wilson	8	225,000	....	....
Ohio:				
Ashtabula	....	....	11	360,000
Carroll	....	....	12.0	372,459
Clinton	....	....	7.5	314,000f
Crawford	....	....	6.34	232,000f
Defiance	5R	106,000f	....	....
Fulton	4R	120,000f	....	....
Holmes	5.97	152,000f	....	....
Madison	....	....	3	130,000
Medina	3.58R	73,910g	....	....
	2	44,118g	....	....
Pickaway	....	....	....	63,288f
Preble	4.05	144,000f	3.87	182,000f
Sandusky	....	....	8a	115,000
Shelby	2	77,000b	3	107,000
Stark	2.62R	102,403d	22.81	....
Oklahoma:				
Blaine	711	2,107	....	....
Caddo	0.25R	8,000	....	....
Creek	3	30,000	....	....
Tillman	9R	....	....	....
Oregon:				
Clatsop	5.5	....	....	....
Douglas	1 1-3	33,000f	....	....
Yamhill	0.75	10,000d	....	....
Pennsylvania:				
Erie	....	719,176f	....	....
Indiana	102,042R	452,512c	....	....
South Carolina:				
Orangeburg	2	....	....	....
Texas				
Cameron	20R	750,000f	....	....
Collin	3R	....	....	....
Orange	5.25R	160,000f	....	....
Smith	40,000	100,000d	....	....
Titus	350,905R	....	....	....
Washington:				
Lincoln	4.2	163,000c	....	....
Snohomish	3	75,000g	....	....
Spokane	8.7	219,300f	....	....
Whatcom	23,732	45,328	....	....
West Virginia:				
Cabell	....	282,245f	....	....
Marshall	....	....	1,000	....
Monongalia	9	284,000d	....	....
Upshur	3	135,000	....	....
Wisconsin:				
Dane	....	10,000	....	....
Grant	1R	21,065f	....	....
Jefferson	20R	600,000f	....	....
	24	500,000f	....	....
Milwaukee	18	....	....	....
Richland	0.25R	2,680f	....	....
Vernon	0.64R	23,801f	....	....
Waukesha	30R	900,000f	....	....

a—Surface only. b—Includes bridges. c—Includes culverts. d—Includes bridges and culverts. f—Includes grading, bridges and culverts. g—Includes grading.

BITUMINOUS MACADAM AND BITUMINOUS CONCRETE LAID IN 1923

State and County	Bit. Macadam Amount	Bit. Macadam Cost	Bit. Concrete Amount	Bit. Concrete Cost
Arkansas:				
Conway	9	141,000	......	......
California:				
San Joaquin	25	235,000g	......	......
Sutter	3.83	42,137g	......	......
Connecticut:				
New Haven	5,000	9,150g	......	......
Indiana:				
Jackson	....	......	2,500	3,000d
Warrick	12	250,000g	......	......
Kansas:				
Bourbon	5	......	......	......
Crawford	4	86,000	......	......
Marion	....	......	0.5	19,000f
Montgomery	6	130,000f	......	......
Kentucky:				
Clark	....	11,000	......	......
Kenton	9.6	67,500f	......	......
Shelby	33	45,000	......	......
Michigan:				
Genessee	....	......	3.995	140,000f
Kalamazoo	....	......	2.50	89,000f
Kent	....	......	6.133	185,730f
Missouri:				
Pettis	4.5	59,000	......	......
New York:				
Cayuga	32	......	......	......
Chautauqua	1	......	......	......
Jefferson	225,000	......	......	......
Madison	14	121,660g	......	......
Niagara	10	125,000f	......	......
Orleans	13.5	200,000g	......	......
Schuyler	6.75	......	......	......
Yates	3	100,000g	......	......
Ohio:				
Carroll	5.8	115,150	......	......
Crawford	2.69	57,000f	......	......
Defiance	8.75	136,000f	......	......
Erie	43,000	113,000f	......	......
Medina	2	43,695g	......	......
Pickaway	4.785	128,566f	......	......
Putnam	....	......	......	131,073a
Sandusky	....	......	3.35	95,000f
Stark	0.39	7,500d	......	......
Oregon:				
Marion	....	......	35	350,000f
Tennessee:				
Hawkins	300,000	......	......	......
Knox	2	26,000d	......	......
Rutherford	....	18,000	......	......
White	13.5	......	......	......
Texas:				
Johnson	100,000	53,000	......	......
Smith	20	100,000c	......	......
West Virginia:				
Greenbrier	21,600	38,000	......	......
Marshall	110,000	......	......	......
Wisconsin:				
Door	22	88,000g	......	......
La Crosse	32.9	173,855f	2.4	7,000f
Vernon	0.62	5,962f	......	......

a—Kentucky rock asphalt. b—Includes bridges. c—Includes culverts. d—Includes bridges and culverts. f—Includes grading, bridges and culverts. g—Includes grading.

(*Continued from page* 126)

minous macadam, bituminous concrete, cement concrete reinforced, cement concrete not reinforced, brick, and other kinds.

"How much of last year's work was done by contract? How much of this year's work will probably be done by contract?"

One of the features of these tables that impresses one is the large sums of money reported as spent last year or available for 1924, and the fact that the largest are those furnished by the states. For instance, under the amounts available for 1924 we find Pennsylvania with nearly 46 million furnished by the state, while the federal aid funds will amount to about 5½ million and those furnished by counties and other political subdivisions total a little under 6 million. Illinois has already under contract $28,000,000 worth of pavement. New Jersey reports that the state will furnish this year 17 million dollars; 10 million each will be furnished by the states of Michigan, Missouri and Ohio, while four other states will furnish more than 5 million each.

Considering the total sums available from all sources for highway work under state or county supervision, Pennsylvania reports over 57 million, Ohio 20 million, New Jersey nearly 18 million and five other states over 10 million each. Altogether, the total for all the states probably approximates $300,000,000 for work under state and county supervision. If we add to this the funds

(*Continued on page* 138)

HIGHWAY WORK UNDER STATE SUPERVISION

Miles Done in 1923

State	Grading	Earth Surfacing	Gravel	Plain Macadam	Bituminous Macadam	Bituminous Concrete	Concrete, Reinforced	Concrete, Not Reinforced	Brick	Other Kinds
Alabama	......	....	99.48	6.00	26.04	.....	....	.....	....	Sand-clay, 39.91; Surface treat., 11.6
Arkansas	......	225	400	10	40	50	....	42	....	....
California	171.2	....	171.2	.....	49.3	92.5	....	170.0	....	....
Colorado	585	....	627	.....	.....	.....	....	79	....	....
Connecticut	0.15	....	10.7	39.9	23.4	3.27	....	40.7	....	....
Delaware	......	....	.....	.....	.....	.....	....	90	....	....
Florida	34.9	39.4	.....	.....	45.5	.....	....	30.1	1.7	Sheet asphalt, 4.3; Surface treat., 35.1
Illinois	202.36	....	50.35	6.41	.....	.....	1,013.52	....	14.74	....
Indiana	25	....	18.6	.....	13.47	.....	....	150	....	....
Iowa	837	....	445	.....	.....	.....	100.7	.....	....	....
Kentucky	135	....	24	73	13	.....	12	.....	....	Rock asph., 25; surf. treat. macadam, 20
Maine	......	....	80	.....	17.7	.....	....	9.67	....	....
Maryland	4.53	....	47.11	.....	29.69	.....	....	129.45	....	12.23 miles asphalt
Massachusetts	......	....	50.13	1.20	79.10	28.26	27.64	....	....	....
Michigan	111.74	....	281.15	32.28	20.92	18.37	151.21	76.87	....	Surface treated macadam, 22.49
Minnesota	1,309	....	1,477	.....	.....	.....	....	.....	....	....
Missouri	594.7	....	289.8	.....	17.3	.....	....	110.9	....	22.4
Montana	......	25	86	.....	.....	.....	....	4	....	....
Nebraska	42	....	14.7	.....	.....	.88	15.37	.....	8.67	....
Nevada	30.8	....	159.3	.....	20.6	1.59	....	6.9	....	....
New Hampshire	3.0	....	72.5	2.0	12.0	6.0	2.5	.....	....	Oiling, 560
New Jersey	......	....	10.08	.....	.....	18.70	72.66	....	....	Sheet asphalt, 2.41; National, 1.15; asphalt block, 0.07
New Mexico	13.4	....	135.6	.....	.....	.....	4.9	.....	....	....
North Dakota	825	....	285	.....	.....	.....	2	.....	....	....
Ohio	27.6	....	2.8	14.7	84.6	7.7	121.6	33.8	120.8	23.6
Oregon	225	....	435	.....	.....	.....	....	.....	....	....
Pennsylvania	......	9,500[a]	....	465	96[b]	.....	350[c]	....	1.24	....
Rhode Island	......	....	3.0	1.0	8.6	5.2	6.7	.....	....	....
South Carolina	509.34	433.10	23.60	.....	.....	27.63	....	13.96	....	Sheet asphalt, 11.05
South Dakota	620	....	250.0	.....	.....	.....	1	.....	....	....
Utah	8.1	....	80.58	.....	.....	.....	....	13.88	....	....
Vermont	128	....	137	.....	7	.....	....	.....	....	50 bridges
Washington	22	....	126	.....	.....	.....	56	.....	....	....
West Virginia	6,275,000†	....	40,000*	200,000*	506,000*	84,000*	....	115,000*	....	....
Wisconsin	1,281	....	1,639	30	.....	.....	444	.....	....	Sand-clay, 261
Wyoming	......	158	....	116.9	.....	5	....	....	....	....

*—Square yards. †—Cubic yards. [a]—General repairs. [b]—Includes asphalt and other bituminous pavements. [c]—Includes not reinforced also.

HIGHWAY WORK UNDER STATE SUPERVISION

Miles Contemplated for 1924

State	Grading	Earth Surfacing	Gravel	Plain Macadam	Bituminous Macadam	Bituminous Concrete	Concrete, Reinforced	Concrete, Not Reinforced	Brick	Other Kinds
Colorado	350	....	380	....	....	....	....	145	....	....
Delaware	....	....	....	....	....	....	....	75	....	....
Florida	36.9	205.8	....	....	....	....	....	30.9	....	Sheet asphalt, 59.7; Surface treated, 338.8
Illinois	225.00	....	25.00	25.00	....	....	1,200	....	....	....
Indiana	75	....	7.33	....	3.49	....	....	215	....	....
Iowa	600	....	400	....	....	....	100	....	....	....
Kentucky	150	....	30	70	10	....	40	....	1	Rock asphalt, 25; surface treated-macadam, 20
Maryland	....	....	40	....	20	....	....	100	....	10 miles asphalt
Michigan	65.25	....	287.09	....	2.00	14.50	....	382.54	....	....
Missouri	500	....	300	....	....	....	....	60	....	....
Montana	....	5	160	....	....	....	....	....	....	....
Nebraska	427	35	400	....	....	....	....	....	....	20 miles of bit. concrete, cement concrete or brick
New Hampshire	....	....	70.0	....	10.0	10.0	2.5	....	....	....
New Jersey	....	....	....	....	0.44	....	87.93	....	....	Sheet asphalt, 5.25
New Mexico	....	....	363.6	....	....	....	....	15.1	....	....
Rhode Island	....	....	2.5	....	8.8	8.0	20.7	....	....	....
South Carolina	....	....	566[a]	....	....	20[a]	....	....	....	....
South Dakota	575	....	375	....	....	....	....	....	....	....
Utah	....	....	255	....	....	....	....	22.3	....	Sand-asphalt, 0.7
Vermont	....	....	150	....	4	....	10	....	....	100 bridges
Washington	55	....	205	....	....	....	51	....	....	....
West Virginia	....	150	....	85	....	....	....	....	....	....
Wisconsin	1,000	....	1,300	20	20	....	275	....	....	Sand-clay, 250
Wyoming	120	....	100	....	18	....	....	....	....	....

[a]—Approximately 566 miles of top soil, sand-clay and gravel, and 20 miles of sheet asphalt and asphaltic concrete.

DAY LABOR, CULVERTS AND REINFORCEMENT

State and County	Amount of Work to Be Done By Contract	Day Labor	Materials Used for Culverts*	Kind of Reinforcement Used
Alabama:				
Lee	All	None	Vit. clay	.....
Montgomery	None	All	Vit. clay	.....
Pike	None	3.5 mi.	......	.....
Arizona:				
Maricopa	None	All	Corrugated iron	.....
Arkansas:				
Hempstead	None	All	Cast iron, corr. iron	.....
Newton	None	All	......	.....
California:				
Fresno	All	......	......	.....
Mono	None	All	......	.....
Plumas	None	All	Corrugated iron	.....
San Joaquin	All	None	Poured concrete	.....
San Luis Obispo	All except	Maintenance	Corr. iron, poured	None
Sutter	All except	Maintenance	......	None
Colorado:				
Cheyenne	None	All	Corrugated iron	.....
Lake	None	All	Corrugated iron	.....
Mesa	Federal Aid	County improv.	Cast iron	.....
Rio Blanco	None	All	Corrugated pipe	.....
Florida:				
Broward	Approx. 50%	Approx. 50%	Armco iron	None
Flagler	5 mi.	Repairs	......	.....
Jefferson	State & Fed.	......	None	.....
Santa Rosa	All	None	Poured concrete	40 lb. per square
Georgia:				
Bibb	None	All	Concr. pipe & poured	.....
Walker	33%	66%	Vitr. and concr. poured	.....
Idaho:				
Boise	All except	Maintenance	Corrugated iron	.....
Clearwater	20 mi.	16 mi.	Corrugated iron	.....
Idaho	All	......	Poured & corrugated	.....
Nez Perce	(All) 3 mi.	None	Poured concrete	.....
Power	None	All	Corrugated iron	.....
Twin Falls	All except	Maint. & brid.	......	.....
Illinois:				
Adams	State	County	Poured concrete	None
Bond	2,000 ft.	Undetermined	Concrete	.....
Brown	None	All	Corr. iron, poured	.....
Carroll	All but gradi'g	20 mi. grad.	Poured and corr.	.....
Douglas	$155,000	$21,000	None	.....
Fulton	All except	20 mi. grad.	Poured & concr. pipe	None
Hancock	None	$40,000	Poured & corr. iron	.....
Jasper	1 brid., $224,000	None	Poured concrete	.....
Kane	All	None	Poured concrete	.....
McDonough	......	......	Poured, corr., boiler	.....
Macoupin	$51,000 grav. rd.	All oil & grad. earth rd.	pipes and concrete	
Marion	All bridges over 12 ft. span	100 mi. grad. & small bridges	Corr. and concrete Poured concrete	....
Mason	All	None	......	.....
Monroe	4,000 ft. conc.	$30,000	Poured concrete	½" & ¾" sq. bars
Peoria	4¾ mi. conc. pavement	Remainder with Township help	Concrete pipe	.....
Pulaski	Almost all	All not contracted at satisfactory prices	Vitr. & poured	.....
Putnam	None	All	Poured & conc. pipe	.....
Richland	None	......	Poured concrete	.....
Schuyler	All except earth surface	$100,000	Poured concrete	.....
Stephenson	25%	75%	Poured & corr.	None
Washington	Conc. bridges	All but concrete bridges	......	.....
Illinois (Continued)				
White	All	None	Poured & corr.	½" bars
Will	?	......	Poured corr. & concrete pipe	.....
Winnebago	All	......	Poured concrete	.....
Woodford	Bridge work	All other	Poured, concr. pipe	.....
Indiana:				
Dubois	All	.....	Corrugated iron	None
Franklin	All except	Road repair ($30,000)	Corrugated iron	None
Howard	All except	$100,000 maintenance	Corrugated iron	No. 29 Chicago steel 50 lbs. to 89 per 100 sq. ft.
Jackson	50%	50%	Poured conc., c. i., and corr.	
Jennings	All	None	Poured concrete	.....
Newton	None	All	Poured concrete	None
Posey	All	None	Poured, c. i. & corr.	.....
Spencer	None	None	Corr. iron	.....
Vigo	All except	$200,000 maintenance	Poured, rein. conc. vitr.corr.	None
Warrick	All except	Maintenance	......	.....
Wayne	All	......	Poured concrete	.....
Iowa:				
Adair	None	All	Poured & conc. pipe	.....
Adams	......	All	Conc. pipe & poured	.....
Benton	$25,000	$87,000	Corr. & poured	.....
Black Hawk	All	None	Corr. & poured	½" bars, 30 lb. per square
Boone	$90,000	$85,000	Corr. & concr. pipe	.....
Bremer	All except	Culverts	Corr. & Concr. pipe & poured	.....
Buchanan	All except	Maintenance	Corr. & Concr. pipe & poured	.....
Buena Vista	All except	45 culverts	Corr. & Concr. pipe & poured	.....
Cedar	All	......	Corr. & Concr. pipe & poured	.....
Cerro Gordo	$80,000	$60,000	Corr. & Poured	.....
Chickasaw	All	......	Poured concr.	.....
Clarke	None	All	Corr. & poured	.....
Clayton	$125,000	$50,000	Poured concr.	.....
Crawford	$150,000	$200,000	Poured, c. i., & corr.	.....
Decatur	All except	Maintenance	Corr. & poured	.....
Des Moines	All	None	Poured corr. & concr. pipe	.....
Dickinson	All	......	......	.....
Dubuque	All	None	Poured concr.	.....
Emmet	All except	9 mi.	Poured concr.	.....
Fayette	Gravel surface grading	Bridges and culverts	Poured & corr.	.....
Floyd	70%	30%	Poured concr.	.....
Greene	Paving and gravelling	17 mi. blade work	Concrete pipe	½" rods
Grundy	$100,000	None	Poured & corr.	.....
Guthrie	$40,000	$40,000	Poured concrete	.....
Hamilton	All	......	Poured, corr., vit.	.....
Hancock	All	......	Poured, corr.	.....
Howard	All	......	Poured	.....
Jones	All except	Maintenance	Poured & corr.	.....
Kossuth	All	......	Poured	.....
Lee	None	All	Poured	.....
Linn	Bridges	All other	Poured & corr.	.....
Lucas	Culverts	Maintenance	Poured & corr.	.....
Lyon	All	......	Poured, corr. & concr. pipe	.....
Madison	All except	Maintenance	Poured & corr.	.....
Marion	$100,000	$116,000	Poured & corr.	.....
Mills	None	All	Poured	.....
Monona	Grade & drain	Maintenance	Corr. or concr. pipe	.....
Monroe	All except	Maintenance	Poured	.....
O'Brien	All	......	Poured	.....
Osceola	All	......	Poured & concr. pipe	.....

*The abbreviations stand for vitrified clay pipe, corrugated iron, concrete poured in place, concrete pipe, and cast iron.

DAY LABOR, CULVERTS AND REINFORCEMENT—(Cont.)

State and County	Amount of Work to Be Done By: Contract	Amount of Work to Be Done By: Day Labor	Materials Used for Culverts*	Kind of Reinforcement Used
Iowa (Continued)				
Palo Alto	All except	Maintenance	Poured, corr. & concr. pipe	½" rods
Pocahontas	$100,000	$85,000	Poured & corr.	.....
Poweshiek	$125,000	$50,000	Poured & corr.	.....
Ringgold	80%	20%	Poured	.....
Sac	Bridges & grav.	All other	Poured & corr.	.....
Scott	All except	Maintenance	Poured	Square bars
Shelby	All	......	Poured & corr.	.....
Tama	....	Maintenance	Poured & corr.	⅝" & up, round
Union	All	......	Poured	.....
Van Buren	All except	Culverts	Poured	.....
Warren	All except	Maintenance & some culverts	Poured & corr.	.....
Webster	All	......	Poured & corr.	.....
Kansas:				
Barber	None	All	Poured	.....
Barton	None	All	Poured, concr. pipe, corr.	½" to 1¼" square
Bourbon	......	......	Poured and others	.....
Brown	All	......	Poured	.....
Butler	All F. A.	Maintenance	Poured	.....
Cheyenne	14 mi.	16 mi.	Poured & corr.	.....
Clay	All	......	Poured	.....
Cowley	F.A. & bridges	Maintenance	Poured	Bars
Crawford	16 mi.	......	Poured	.....
Doniphan	$275,000	......	Poured, concr. pipe, corr.	.....
Douglas	None	All	Poured & corr.	.....
Ellis	Federal aid	All other	Poured	.....
Finney	10 mi. gravel	20 mi. grading	Poured & corr.	.....
Ford	Federal aid	Grading	Poured & corr.	.....
Geary	All except	Maintenance	Concr. pipe	.....
Gray	7½ mi. sand-clay	150 mi. grading	Poured & corr.	.....
Harvey	......	All	Poured & wooden	.....
Jackson	All	......	Poured	.....
Kingman	None	All	None	.....
Lincoln	Bridges	Grading	Poured & corr.	.....
McPherson	All	......	Poured	Bars or rods
Marion	All	......	Poured	.....
Miami	All	......	Poured, corr. & concr. pipe	.....
Montgomery	10 mi. macadam	5 mi. macadam & 10 mi. grad.	Poured, corr. & concr. pipe	.....
Norton	All Federal aid	Regrading & maintenance	Poured & corr.	.....
Osage	Bridges & culv.	State aid work	Corrugated	.....
Pawnee	Bridge	Grad., gravel, culverts	Poured, corr or lock joint concr. pipe	.....
Rawlins	$50,000	$21,500	Poured, corr. & concr. pipe	.....
Reno	F. A. bridges	All other	Poured	.....
Republic	$70,000	$20,000	Poured & corr.	.....
Rooks	F. A. & bridges	County grading	Poured & corr.	.....
Sheridan	$52,000	$48,000	Poured	.....
Thomas	7 mi. earth	163 mi. grading	Poured & corr.	.....
Wabaunsee	15 mi.	50 to 75 mi.	Poured & corr.	.....
Wilson	None	All	Poured	.....
Kentucky:				
Boyle	None	All	Poured & corr.	.....
Carroll	All	None	Corrugated	.....
Clark	12.7 mi.	11.3 mi.	Corrugated	.....
Crittenden	Almost all	Not much	Corrugated	.....
Daviess	37 mi.	6 mi.	c. i., corr. & vit.	.....
Fayette	11 mi. constr.	9 mi. construct.; maintenance	Corrugated	.....
Fleming	None	All	......	.....
Kenton	5.5 mi.	10 mi. macadam	......	Bates plan
Leslie	......	......	Concr. slab on stone	.....

(To be continued)

(Continued from page 135)

that will be spent by town and villages and other political units, the total would probably approximate $500,000,000. The Bureau of Public Roads reported, on March 31, that $203,758,000 was available for work under contract, projects approved, and not yet alloted.

The tables also give information concerning construction of highways by day labor. About half of the states report doing almost or quite all of last year's work by contract, and most of the others contracted 60% to 95% of it. Of the counties, about 20% did all highway construction by day labor, 30% did all (except maintenance) by contract, and the remaining 50% did part by each method. Few counties undertook to construct bituminous, concrete or brick pavements, but most confined themselves to dirt roads, gravel and, in some cases, macadam.

STATE CONTRACT WORK AND EQUIPMENT

State	Done by Contract in 1923	To be done by contract in 1924	Does the State Loan Equipment to Counties or Towns?	Does the State Loan Equipment to Contractors?
California	89%	....	......	......
Colorado	All	All	Yes	If idle equipment is available
Delaware	All	All	To a limited extent	Rent a few
Florida	......	....	Yes	Occasionally
Illinois	All but a few sections	Practically all	Rented to counties	Rented to contractors for state roads
Indiana	200 miles of 207	All but about 7 miles	No	No
Iowa	All	All	Yes, war equipment	Some
Kentucky	All	90%	No	No
Maryland	All	All	No	No
Massachusetts	Approx. $7,000,000	Approx. $8,000,000	Yes	No
Michigan	All, but $75,000 with prison labor	All but 75 to 100 mi. of concrete to be done with prison labor	No	Only special cases
Missouri	All	All	No	No
Montana	All, but 3 miles with convicts	All, but 4 miles with convicts	No	Leases
Nebraska	All	All	Loans or sells	Leases for state work
New Hampshire	......	50%	......	......
New Jersey	All but 3 mi.	All but 8 mi. with convict labor	Yes	Yes; has rental schedule
New Mexico	......	All	......	......
North Dakota	All	All	Yes	Yes
Ohio	......	All but 500 miles gravel	......	......
Pennsylvania	374.92 mi.	104 mi.	Yes	Yes
Rhode Island	All but 2 mi. of gravel	All	No	Generally rents
South Carolina	90%	90%	Occasionally	Seldom
South Dakota	95%	All but 200 miles blade grading	Leases	No
Utah	All	Almost all	Leases	Yes
Vermont	......	$400,000; $700,000 by day labor	......	......
Washington	89%	93%	......	......
West Virginia	......	All	......	......
Wisconsin	60%	60%	Yes	No
Wyoming	65%	75%	No	Yes

Recent Legal Decisions

FORFEITURE OF DEPOSIT WITH BID ON HIGHWAY CONSTRUCTION

The Washington statute, Rem. Comp. Stat., §6408, provides for the forfeiture of the certified check of a successful bidder for a highway contract for 5 per cent of his bid deposited with bid, on his failure to enter into a contract with the county and furnish bond within five days after notice of award. The Washington Supreme Court holds, Hilstad v. Ketsap County, 215 Pac. 12, that the refusal of a bank which had agreed to furnish the required bond to do so did not prevent forfeiture of the bidder's check. The section was intended not only to secure good faith on the part of the bidder, but to limit bids on public work to those competent and financially able to carry out the contracts. It also provides a method of reimbursing the county for the time lost in proceeding with the work and the expense incurred. The court distinguished the case from that where there was undisputed evidence of a mistake in figuring the amount of the bid, when the amount of the check could be recovered (Donaldson v. Abraham, 68 Wash. 208, 122 Pac. 1003).

MUNICIPAL BONDS FOR WATERWORKS—MAJORITY OF VOTES CARRIES PROPOSITION

While the North Dakota courts hold that the proposition of issuing bonds must be submitted to the voters in such a way as not to involve two or more distinct and unrelated questions, the Supreme Court holds, Logan v. City of Bismarck, 194 N. W. 908, that a submission by the city commission of a proposition to issue bonds in a stated amount for "constructing or purchasing" waterworks for the city is a single question, and is therefore not within the condemnation of that rule.

Under the North Dakota statutes and decisions a majority of the votes cast upon the question of bonding the city for the purpose of constructing or purchasing waterworks, if in the affirmative, carries the proposition, and it is not necessary that a majority of all the legal voters of the city vote in favor thereof.

SUFFICIENT DESCRIPTION FOR JUDICIAL ROAD—PRESUMPTION OF NECESSITY FOR HIGHWAY

The Minnesota Supreme Court holds, In re Judicial Road in Scott and LeSueur Counties, 194 N. W. 775, that a petition for a judicial road which states that it begins at a given point and extends due south on designated section lines to a given point sufficiently describes the road, although there may be correction lines which will vary the road from a due south course.

It is also held that the propriety of establishing a public highway is a purely legislative question. When a highway has been established in the manner authorized by the Legislature, the necessity for it is presumed, and this presumption can be overcome only by showing conclusively that it will serve no public purpose.

RECOVERY BY SUBCONTRACTOR ABANDONING WORK OR PREVENTED FROM COMPLETING WORK

In an action by a subcontractor against a contractor for the construction of a dike, the Michigan Supreme Court holds, Oakley v. Superior Dredging Co., 194 N. W. 123, that if the subcontractor had breached the contract, he would still be entitled to recover for any valuable services he had performed for the contractor under the contract, of which the contractor had reaped the advantage, less any damages the latter might have suffered by the failure to complete performance. If the subcontractor did not breach the contract, and if the contractor prevented full performance, the subcontractor might recover the value of the work and labor performed, not exceeding the contract price. Testimony of the total price paid the principal contractor by the owner under the contract was held inadmissible.

CONTRACTOR'S LIABILITY FOR CAVING IN OF REFILLED TRENCH

In an action against a paving contractor for damages for personal injuries caused by falling into an excavation, which had been refilled after asphalting though the surface had not been repaved, and which had caved in after a heavy rainfall, the New York Court of Appeals, Brown v. German Rock Asphalt Co., 236 N. Y. 271, 140 N. E. 695, reversed a directed judgment for the defendant by the Appellate Division (204 App. Div. 856, 197 N. Y. Supp. 901) and granted a new trial, for the following reasons:

Where one under a contract with a municipal corporation has made an excavation in a public street or highway and refilled the same, it is his duty to anticipate the result upon it of a rainfall, and to see that during and after a rain it is in a proper and safe condition, or to take such measures of prudent forethought as will protect the public passing by from danger, at least while it is under the contractor's control. The street did not remain as the defendant left it. At the time the plaintiff fell while alighting from a street car a hole 3 to 5 inches deep had been worn in the covering or gravel.

The defendant, having opened the street, dug the trench, and refilled it, was held to be charged with the duty of restoring it to a reasonably safe condition. As its contract was not complete until it had resurfaced the trench, it still had power and the right of supervision over it. Its work was not complete. Under these circumstances it was held called upon to exercise reasonable care to keep the highway reasonably safe until the asphalt had been replaced, or the street repaved. Whether it exercised such care was a question of fact for the jury upon the evidence, and it was held error to dismiss the complaint.

Two judges dissented for the reason that the character of the depression, including the length, width, and depth of it, would not, under numerous decisions of the Court of Appeals, have made the

city liable, and no greater obligation was imposed upon the contractor than upon the city; and also, assuming the contractor might have been subjected to liability, because no proof had been offered that the contractor, prior to the accident, had actual or constructive notice of the defect.

CONSTRUCTION OF STATUTES CONCERNING ANNEXATION BY CITIES OF ADJACENT TERRITORY

It is a settled rule of statutory construction that a statute must be construed with reference to other statutes concerning the same subject-matter, or a part of the same general system of legislation, and to the history of the times when enacted; and it is presumed that the Legislature did not intend absurd or unjust consequences, or great public inconvenience.

Construing section 3753 North Dakota C. L. as amended by chapter 68 of the Session Laws of 1915, with reference to the annexation of territory by cities, the North Dakota Supreme Court holds, Village of North Fargo v. City of Fargo, 192 N. W. 977, that a city may not annex a portion of the territory within the limits of an incorporated village, although a part of the boundaries of the village borders upon and adjoins the boundaries of the city.

The Wisconsin Supreme Court holds, City of Wautotosa v. City of Milwaukee, 192 N. W. 982, that the Wisconsin St. 1919, §§925-17, 925-18, the general statute as to annexation of territory lying adjacent to a city, considered with section 925-21d as to detachment of territory from a city of the fourth class, is inapplicable to annexation by one city of land adjacent to it, but constituting part of the territory of another city, of the fourth class. The two statutes must be harmonized so as to leave vitality to one by giving a limited interpretation to the broad language of the other.

FAILURE TO COMPLY WITH STATUTE AS TO ADVERTISING FOR BIDS RELEASES CONTRACTOR

The Ohio Supreme Court holds, State v. Kuhner, 140 N. E. 344, that the requirement of section 1206, Ohio General Code, that "the state highway commissioner shall advertise for bids for two consecutive weeks," is mandatory, and a contract for a highway improvement entered into on June 14, after advertisement in two weekly newspapers of the county on June 6th and June 13th, is invalid. In an action against the contractor and his surety to recover damages for failure to enter upon and complete the contract, such invalidity is a complete defense. The contract cannot be validated by the passage of a so-called curative act after the contractor's default, and the construction of the improvement by the state.

RECOVERY FOR ADDITIONAL WORK AND MATERIAL NECESSITATED BY CHANGE IN PLANS AND SPECIFICATIONS

A contract for a public improvement (the enlargement of a waterworks plant), duly executed by a city, expressly reserved the right to require changes in the plans and specifications during the progress of the work, on condition of a proportionate reduction from the contract price of the quantity if work or materials should be thereby reduced, or of a proportionate increase in the contract price if the amount of work or material was thereby increased. Thereafter physical conditions encountered did require such changes, which were made as directed in writing by the city, pursuant to the requirements of the contract. The Supreme Court of Ohio holds, City of Portsmouth v. Nicola Bldg. Co., 106 Ohio Ct. 550, 140 N. E. 174, that the contractor was entitled to recover for such additional work and material in accordance with the terms of the contract.

ACQUIESCENCE IN VIEWERS' REPORT CHANGING LOCATION OF ROAD

An objector to the improvement of a highway has the right, under the Indiana statute, section 7739g, Burns' 1914, to file a remonstrance within 10 days after the filing of the viewer's report, and in case of an adverse ruling to appeal to the circuit court. The Indiana Appellate Court holds, Cole v. Board of Canvassers of Noble County, 140 N. E. 448, that if he fails to exercise this right he will be held to have acquiesced in the viewers' report which made changes in the location of the road as described in the petition.

COST OF SUPERVISION OF WATERWORKS USED BY CITY BEFORE ACCEPTANCE NOT PROVIDED FOR BY CONTRACT

The provisions of a contract, duly executed by a city, for the erection of a waterworks plant, included a provision permitting the city to enter upon and use the whole or any portion of the work in condition to use previous to its final acceptance, of which provision the city availed itself. The Ohio Supreme Court held, in an action by the contractor against the city, John H. McGowan Co. v. City of Portsmouth, 140 N. E. 171, that from such express provision there did not arise an implied contract binding upon the city under which the contractor might recover for engineering supervision, additional skilled labor, and repairs furnished prior to the acceptance of the plant by the city, upon the claim that such supervision, labor and repairs were required safely to operate the plant or maintain it in the condition as installed until its final acceptance by the city.

SERVICE CHARGES IN WATER RATE SCHEDULE VARYING WITH SIZE OF METER

In authorizing a new water rate schedule for the City of Port Washington, the Wisconsin Railroad Commission included therein a graduated service charge varying with the size of installation, to cover such expenses as depreciation, local taxes, interest on the investment, cost of reading meters, maintenance of meters and services and other consumer expense. It was found that under the existing schedule no charges, other than the $6 annual minimum, were being made for emergency water connections for general service or for private fire protection service, although the total cost of serving customers of this latter class is not proportional to the amount of water they use, but depends much more upon the fixed expense caused by preparations to meet their demands.